A

DICTIONARY

OF

ARTILLERY AND OTHER MILIT

AND

SCIENTIFIC TERMS.

COMPILED BY

COLONEL VOYLE, R.A.,

AUTHOR OF "THE GUNNER'S AID"

FROM THE LATEST AND MOST TRUSTWORTHY AUTHORI

' What is obvious is not always known, and what is known is not always present."—J

Second Edition.

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Dedicated,

BY PERMISSION,

TO

SIR ROBERT NAPIER, K C B,

ROYAL ENGINEERS, SENIOR MEMBER OF THE COUNCIL OF INDIA

PREFACE TO THE FIRST EDITION.

IN undertaking to compile the present work, I have had in view the difficulty which officers in India meet with in obtaining books on military and scientific subjects (chiefly from their cost), and when obtained the expense incurred in taking them from place to place With the experience of these difficulties, I conceived the idea of preparing a work which should furnish military men in India with information, in a condensed form, on subjects having reference to military topics of the present day, and so arranged as to afford a ready explanation of such terms as are most commonly used in military life

I originally intended that this work should have comprised only Artillery terms, but, on re-considering the subject, judged it better to add others which I thought would be useful, the science of artillery involving a wider scope than the bare technical terms of that scientific branch of the service afford For easy reference, the subjects are arranged alphabetically, which causes the work to assume the form of a Dictionary, instead of that originally intended

The book is necessarily a compilation, indeed, on the subject of artillery and other military topics at the present day, what work is not so to a great extent ? My intention, therefore, has not been so much to impart original matter, as to disseminate, in a convenient form, information obtained from the best and most trustworthy authorities, from whose works I have freely and *verbatim* extracted, not appending to each extract the author's name, as these are given in detail at the commencement of the book, and it would only involve constant repetition and additional letter-press to recapitulate them

In conclusion, in presenting this volume to the perusal of my brother officers, I must beg their lenient criticism on my labors, and all shortcomings in the scope and execution of the work, my task having been no easy one in a country where it is so difficult to

procure information on military subjects Should the object I have had in view be attained, I shall feel that some good has been done but I shall be equally satisfied if the production of this work be an incentive to others, better qualified than myself, to undertake the same object on a more enlarged scale The following subjects were kindly contributed by the under-mentioned officers —

Accounts, Public	Captain Leonard, Auditor of Ordnance Accounts
Ballistic Pendulum Ballistics Resistance of the Air	Lt-Col Maxwell, R A
Blueing Browning Barrels	Conductor Ford, Ordnance Department
Leather	Mr Teil, Govt Contractor
Moulds for casting Guns	Lt-Col Maxwell, R A

G E V

PREFACE TO THE SECOND EDITION.

I HAVE been induced to bring out a second edition of the Dictionary of Artillery and other Military and Scientific Terms, in the belief that the first has proved useful to military men

As I stated in the former preface, I had hoped that some one more capable would have undertaken the task of enlarging and continuing this work, but I am not aware that any one has done so, or that there is any Military Dictionary of a late date in the English language

The object of the work is to explain to both professional and non-professional men the derivation and application of many of the military terms now existing, and indeed of some words which, though obsolete, are still in use, and these as briefly as may be, since it would be obviously out of place within the limits of a book of this kind to attempt anything like an essay on the subjects contained in it Many terms considered superfluous in the first edition have been omitted in this, and others added, which it is hoped will make the work more useful

Compiled in India, and containing Indian terms, not strictly professional or scientific, the book has been purposely enlarged by the addition of these, for the information and convenience of officers arriving in India for the first time It will be observed that the names of a number of mechanical tools have been given, the use and description of which are fully detailed, and are taken from Haltzapffel's work on Turning These have been added for the assistance of officers newly appointed to the manufacturing departments of the service.

A few veterinary terms have also been inserted, and the remedies for some of the more common complaints to which horses are liable · these, cavalry and artillery officers may find useful in the absence of a veterinary surgeon

In this, as in the first edition, extracts have been freely made from all available authors on military and scientific subjects, and these are acknowledged either at the commencement or in the body of the work. The transition state of the *matériel* of the army, especially in the artillery branch, renders it difficult to state determinately in all cases what may be considered as fixed patterns, amongst the many changes which are constantly taking place, but I have endeavored to follow these changes as far as information has been available This second edition is now given to the public in as concise a form as possible, as a book of ready reference for the terms in common use amongst military men in all branches of the service

I am indebted to Lieutenant Waterhouse attached to the Surveyor-General's Department for the paper on Photozincography

G E V.

THE FOLLOWING WORKS HAVE BEEN CONSULTED AND EXTRACTED FROM, IN THE COMPILATION OF THIS DICTIONARY —

Aide Memoire to the Military Sciences
Ammunition, Treatise on, by Captains Majendie and Orde Browne, R A
Army Equipments, Parts 1, 2, 3 and 4 Published by order of War Office
Artillerist's Manual, by Major Griffiths, Parts 1 and 2
Artillery, Dictionary of, by General Catty
" Exercise, Field
" Institution Papers, Royal, published at Woolwich
" Lectures on, by Majors Owen and Dames, R.A
" Modern, by Lieut -Col Owen, R A
" Treatise on, by Lieut -Col (now General) Boxer, R A
" " published at Bombay
" " by Decker
Astronomical Atlas by Milner
Baker's Elements of Mechanism
Balfour's Cyclopædia of India
Brande and Cox's Dictionary of Science and Literature, 1867
Bourne on the Steam Engine
Cape's Mathematics
Cavalry Manual, by Colonel Ainslie
Change of Materiel, by War Office
Chemistry as applied to the Arts and Manufactures, by Dr Sheridan Muspratt
" Handbook of, by Abel and Bloxam
" Manual of, by Dr O'Shaughnessy
Compilation of Standing General Orders
Construction of Dwelling-houses
Defence of Military Outposts, by Captain Jebb, R E
Dictionary, Naval and Military, by Col Burns, late R A
" of Terms of Art, by Weale
" of Arts and Sciences, by E Francis, F L S
" of the English Language, by Johnson
" " " " by Webster
" " " " by Hyde Clarke, LL D
" " " " by Smart
" of Military Science, by Lieut E. J A Campbell
" Military and Naval, by James
" Philosophical, by Hutton
Elementary Mechanics, by Goodwin
Field Exercise and Evolutions of the Army, for 1870
" Fortification, by Macaulay
Fortification, by Major Straith

Gunnery, by Hyde.
,, Naval, by the late Sir H Douglas
,, by Lieut Simpson, U S Navy
Gunpowder, by Majors Baddeley, Anderson, and Goodenough, R A
Haltzapffel's Turning and Mechanical Manipulation
Handbook for Field Service, by General Lefroy, R A
,, ,, of Natural Philosophy by Lardner
,, ,, of the Mechanical Arts, by R. Scott Burns
Heather on Mathematical Instruments
Indian and Burman Timbers, by Conductor Skinner, Gun-carriage Department, Madras
Instruction in Military Engineering, Volume I, of 1870
Manual of Military Law, by Colonel Pipon and J Collier, Esq
Mayhew on the Horse
Mechanic's Magazine
Military Examination, by Col Sir J Alexander, Kt
,, Resources of Prussia and France, by Chesney and Reeve
Motion of Projectiles, by Lieut -Col Owen, R A
Queen's Regulations and Orders for the Army
Report on Phosphoric Bronze as applied to Artillery, by Colonel H Maxwell, R A
Small's Veterinary Tablet
Steam Engine, by Robert Scott Burns
Theory of War, by Colonel Macdougall
Tomlinson's Cyclopædia of Useful Arts and Manufactures
Vocabulary of Military and Marine Terms, by Sir A Alison, Bart

ABBREVIATIONS

B L	Breech-Loader
F G	Fine Grain
L G	Large Grain
M L	Muzzle-loader
M L R	Muzzle-loading Rifled
N C O	Non-Commissioned Officer
R F G	Rifle Fine Grain
R L G	„ Large Grain
S B	Smooth Bore
N P	New Pattern
R P	Royal „

[NOTE —Where French terms occur in the black type throughout the work, the accentuating marks have been unavoidably dispensed with]

A
DICTIONARY OF ARTILLERY
AND OTHER
MILITARY AND SCIENTIFIC TERMS.

Abandon — To retire suddenly from a place, fortified or otherwise, thus leaving it and the inhabitants to the mercy of the enemy Hence the saying, to abandon a fortress, siege, &c

Abatis—Lines of felled trees of a considerable size, their stems strongly bound together and secured to the ground by a crotchet picket , the larger branches being spread towards the enemy and interlaced as much as possible, the smaller being cut away, and the boughs well pointed Abatis should be so placed as not to be exposed to the fire of Artillery. In intrenchments, they are usually placed in an upright position against the counterscarp, or at the foot of the glacis, the plane of which is broken so as to permit of their being laid out of the enemy's sight, and at the same time not to interfere with the musketry fire from the parapet in their rear An excellent mode of blocking up a road is to place an Abatis across it, and when the branches are well and properly placed, and interwoven one within the other, the disentangling of them is extremely difficult An Abatis should not be planted out of musketry range , for this and all other obstacles are to break up the order of the enemy's advance, to impede and to keep him under musketry fire

Trees cut half through form insurmountable obstacles this kind of Abatis is called an *Entanglement*

About—A well-known word on the drill ground, and nearly the first word with which the recruit becomes familiar It expresses the movement of a soldier or body of troops when ordered to face in the direction required.

Academy—Takes its name from a villa situated about a mile from the

city of Athens, where Plato and his followers assembled for conversing on philosophical subjects, and hence they acquired the name of *Academics* The term *Academy* is frequently used now for a regular society or company of learned men, associated together for the cultivation and improvement of the Arts and Sciences In England there are several institutions termed academies for the promotion of the Arts The Military Academy at Woolwich, for the instruction of the Artillery and Engineers of the Army, was instituted by George II

Accelerated Motion — Is when a body continually increases its motion over successive portions of space in equal times It is called *Retarded Motion* when the spaces described continually decrease

Accelerating Force—Force considered only with reference to velocity generated, and not with reference to the mass moved *Accelerating Force*, if uniform, is measured by the velocity generated in a unit of time, if variable, by the velocity which would be generated in a unit of time if the force were continued constant during that unit

Accessible—A position, fortified or otherwise, capable of approach by land or water,—*i e*, it may be entered on those sides

Accounts, Public—Form the systematic record of State Expenditure The accounts kept should exhibit, methodically, under proper heads, all receipts and disbursements of public money, stores, &c To secure efficiency in these matters, accounts should be promptly rendered in the simplest and most correct manner

The Indian Ordnance Accounts are framed in this manner, and afford information on all points connected with Debits and Credits Debits and Credits are abstracted under each head of service for which supplies of stores are given from Ordnance Magazines, or received into them

The following books should be kept up with this view in Arsenals and Magazines

1 Day Book
2 Abstracts and Journals
3 Ledgers
4 Work Reports, or out-turns, of Manufactories, with their vouchers, viz

1 Indents
2 Receipts
3 Survey Reports
4 Invoices
5 Direct authority of Government

The Day-Book forms the foundation of the other accounts, and should exhibit, therefore, every transaction of a Department in the clearest manner, viz

Head of Service
Date of Transaction
Party concerned, Name, Rank, &c.
Rate of Articles
Value of Articles

When this is done correctly, there is no difficulty whatever with the most voluminous accounts

Probable expenditure is ascertained by Budget Estimates, framed by heads of Departments from the subsidiary Estimates of Executive Officers, calculated from previous expenditure of a like nature, and from a knowledge of any excess or diminution in expenditure that may probably take place during the year estimated for At the end of six months, actual results are reviewed with the estimates, and additions or reductions made as may be necessary.

To ascertain actual results, they should be tabulated under the minor

heads of the Budget at the close of every week, keeping the expenditure of the year estimated for distinct from arrears of former years These tabulations are readily made from Day and Bill Books, and when posted regularly, form a trustworthy guide for officers whose province it is to contrast and check the expenditure of the year, &c

Accoutrements—Signify the belts, pouches, &c, of a soldier Those in use in the British Army are made, for the most part, of "buff" leather It is laid down in the Queen's Regulations, that every article of regimental accoutrements and appointments is to be marked with the number or appellation of the regiment to which it belongs The marks are to be carefully and legibly placed on the inside of the belts, pouches, and slings

Achromatic — Without colour In optics, an arrangement of lenses to obviate aberrations and colours

Acid, Nitric (No [5])—Found in combination with potassa, soda, lime and magnesia, also in the pools and springs in the neighbourhood of populous towns, and in rain water after thunder storms, but it has never been found in a separate state Nitric acid is commonly prepared from sulphuric acid (oil of vitriol) and nitre, by distillation There are also other processes pursued in preparing nitric acid The impure nitric acid of commerce is known by the name of "aqua fortis"

Nitric acid is one of the ingredients used in browning arms, and also in the preparation of fulminate of mercury It is also used, in combination with sulphuric acid, in the preparation of gun-cotton, and, in solution, as a bath for galvanic batteries It is a powerful oxidizer, and acts strongly on metals A few drops poured into the vent of a spiked gun will facilitate the operation of extracting the spike

Nitric acid when received from the chemist should not be of less specific gravity than 1 450 or 1 400 For percussion cap purposes it is diluted down to 1 350, it should not, however, be received except at the above-named specific gravity

To test nitric acid, dilute half an ounce of it in a quarter of an ounce of distilled water, then pour in, say, six or seven drops of nitrate of barytes; should it retain its colour, it indicates that it is free from muriatic acid As nitric acid also contains sulphuric acid, pour in a few drops of nitrate of silver, when, should it remain colourless, it is free from the above-mentioned acid

Acid, Sulphuric (SO_3)—One of the most important acids known In Southern India it has been prepared for many centuries Dr O'Shaughnessy thus describes its value —"It would be impossible to exaggerate the importance of this acid, whether we consider it with reference to abstract science, to the condition of our manufactures, or the purposes of medicine. By the assistance of this acid we prepare almost all the others, for instance, the nitric, muriatic, tartaric, citric, &c We owe to it the cheapest mode of obtaining artificial soda, chlorine, and its bleaching components It is essential to the processes of the dyer In fact, from the time that sulphuric acid was first prepared at a cheap price in Europe, may be dated the commencement of her greatness in all chemical manufactures" The process pursued in the preparation of sulphuric acid will be found in all chemical works

Sulphuric acid, in a diluted state, is made use of in percussion cap fac-

tories, the sheets of copper being steeped in a solution of it, to free them from oxide of copper. It is also used in the preparation of gun-cotton

Acids—Form a very numerous and important class of bodies in chemistry The common idea of an acid is a soluble substance possessing the property of sourness The chemist, however, disregards this property, and considers all those substances to be acids which impart a red colour to blue litmus paper, and form stable, neutral, and crystallizable compounds with bases, such as alkalies and earths, or metals or their oxides

Action—An engagement or battle between opposing forces, or some memorable act done by an officer, soldier, or detachment The term is commonly used in artillery when guns are brought into, or change position, with the view of attacking an opposing object

Acts of Hostility—Proceedings of a diplomatic, commercial, or military character, involving a state of war between two or more nations This was recently exemplified in the altercation between Count Benedetti, the French ambassador, at the Court of Berlin, and the King of Prussia at the Kursaul of Ems. This is an instance of the first named act of hostility The second is shown in the case of the embargo laid on British shipping by the first Napoleon after the peace of Amiens in 1803 The third consists in the invasion of a friendly territory or firing on armed vessels of a friendly nation A further act of hostility of a civil character is the forcible detention of the subjects of a friendly nation, which is exemplified in the seizing of non-belligerent British subjects residing in France in 1803

Adapter—A gun-metal bouche, used when shells are fired with fuzes which are not adapted to the fuze-hole. The pattern adapter now in use is known as the "general service adapter." Up to the year 1867 all shells for the larger rifled ordnance down to the 40-Pr L S and the 20-Pr. S S. common shell, were made with the Moorsom or naval fuze-hole Since then all new shells have been tapped with—what is termed—the general service fuze-hole, and shells already in the service which do not fit this hole are to receive the general service adapter. The shape of the inside of the adapter is conical, the outside cylindrical

Adjutant—An officer appointed to each regiment in the service, to assist the commanding officer in the execution of all the details of regimental duty and discipline

An adjutant is appointed to each brigade of artillery, also to divisions of artillery of two or more batteries detached from their head-quarters. The duties of an artillery brigade adjutant in India are, to a great extent, confined to his office, as the several batteries composing his brigade are often-times stationed far from their head-quarters In his office are kept the records of the brigade; from it he circulates to detached batteries all orders received from the commanding officer and higher authority, as well as regimental orders. He prepares correspondence on questions relating to the claims, services, enlistment, discharges, &c, of the men of the brigade, and when acting as the staff officer of the R.A in the division, he has to prepare all local returns which are submitted to the general officer commanding He has, besides, to attend to the usual duties of the guards, prisoners, courts-martial, &c As regards drill, commanding officers of batteries work their own drills inde-

pendently, and recruits are trained at Woolwich The adjutant is responsible to the commanding officer for the state of exactness with which the regimental books are kept, and for the correctness of the duty rosters He is to give his attention to every thing appertaining to the discipline of his brigade, bringing to the notice of the commanding officer any irregularity or deviation from the established rules and regulations In fact, nothing should escape his attention and observation

Adjutant-General.—The senior staff officer of the Army in times of peace, through whom all orders from the Commander-in-Chief emanate, and to whom all reports are sent for his information The duties of the Adjutant-General relate to the general discipline of the Army On a campaign, he regulates the daily duties of the force, and during a siege, details the working parties on the requisition of the Commanding Engineer All correspondence, which has for its object the armament of fortresses, batteries, and the arming of troops, passes through him He keeps an exact state of each division and brigade, with a roll of the general and field officers, he distributes the Orders of the Day to the several Assistant Adjutants-General of divisions, and informs them of every detail which may concern them

Advanced Chains—In a siege carriage, are attached to the bolster and splinter bar inside the iron stays

Advanced Guard—A detachment of troops composed of the three arms, and which always precedes the march of the main body of an army In the Queen's Regulations, it is directed that on a single regiment commencing its march, an advance guard is always to be formed.

Advanced Posts — Positions taken up by a force in advance of the main body of an army, and in such a situation that they shall be within easy communication of it, and of one another; but the distance depends greatly on the nature of the country. The object of advanced posts is to prevent a sudden rush of the enemy upon the main body, and to give it time to turn out this being afforded, the advanced posts fall back on their supports, and join the main body

Advancement—In a military sense, signifies honor, promotion from a lower to a higher grade, or preferment, in an army, regiment, or company

Adze, Carpenter—A tool having a slightly curved blade, and its edge at right angles to the handle , used for paring a very large or nearly horizontal surface

Adze, Cooper—Is a small hand instrument for cutting the borders of barrels to an equal size or measurement

Adze, Indian, or Bassoolah—Is a small adze, which, in place of being circular like the European adze, is formed at a direct angle of about 45 or 50 degrees , its handle is very short, and it is used with great precision by the nearly exclusive motion of the elbow-joint

Aeen—(*Terminalia glabra*) —A tree which grows in the Madras Presidency at Coimbatore It is very hard, heavy, and durable under water It is said to be found in all the teak forests of India and Burmah A cubic foot of unseasoned wood weighs from 70 to 73 lbs It is used in the Bombay Gun-Carriage Agency for shafts, handspikes, and yokes

Affair—In a military sense, means any minor action or engagement

Affidavit—In military law, im-

plies an oath in writing, sworn before a person duly authorized to administer it

Affinity—In chemistry, the force which causes particles of dissimilar kinds of matter to combine together, so as to form new matter

Affirmation—Is a solemn declaration made before a Court of Justice or Court-Martial by those who, from different views of religion, are considered incompetent, or are unwilling, to give evidence on oath, as ruled in our several Courts Formerly, no evidence could be given except upon oath, but the privilege of making solemn affirmations, instead of swear ing on the Bible, has been extended to Quakers, Moravians, and Separatists, in all cases, and to persons alleging conscientious motives in civil proceedings.

Before Native Courts-Martial in India, evidence is given on solemn affirmation

Agent—A deputy a person employed to transact the business of another In India, the term is applied to certain high officers of the State, to whom are committed by the Viceroy political powers in dealing with a foreign State The term is also used in a military sense, by the Government of India, as a substitute for Superintendent,—such as Agent for Gunpowder, Agent for Gun-Carriages The term, however, of Superintendent would be more appropriate

Aide-de-camp—An officer appointed to attend a General Officer in the field, or in garrison He receives and carries the orders required This is a post of great importance during a campaign, and only officers of intelligence and smartness should be appointed It is stated by Marshal de Puysegur that the loss of a battle was occasioned by the incapacity of an Aide-de-camp.

Aides-de-camp are also attached to the Sovereign, and to Governors of Provinces, in the former case, the appointment carries with it the rank of Colonel in the Army, and, under certain circumstances, is a paid position

Aim—In drill or action, bringing the musket or piece of ordnance to its proper line of direction with the object intended to be struck

Air Gun—A pneumatic machine for propelling bullets, which, by its peculiar formation, admits of the air being compressed or condensed within it, in a strong metal ball, furnished with a small hole and a valve opening inwards This ball is screwed to a barrel containing a bullet, when, upon turning a cock and opening a communication between the condensed air and the bullet, the latter will be projected forward with a greater or less velocity according to the state of the condensation and the weight of the bullet

Air Pump—Is a machine constructed for exhausting the air from a closed vessel, which is called a *receiver* It consists of a glass-receiver, and a pipe connecting it with two barrels by means of two valves, which open upwards In these barrels are two air-tight pistons, also furnished with valves opening upwards, which are worked up and down by means of a rack and wheel The principle of the air pump is as follows —The pistons work up and down alternately, one ascending as the other descends The piston rising from the bottom of the cylinder causes a partial vacuum, and the elastic force of the air in the receiver pressing on the valve, opens it and fills the cylinder. On the descent of the piston, the valve in the pipe leading to the receiver closes by the pressure of

air on it, and the valve in the piston opens from the same cause, until all the air in the cylinder is expelled A succession of strokes in this way rarifies the air in the receiver, until the elastic force of all that remains is insufficient to open the valves, when the action of the pump ceases

Air, resistance of — More especially with reference to projectiles, is of the highest importance in the science of Ballistics The resistance increases in a high ratio with the velocity Without this resistance a musket ball would, at an angle of 25°, be thrown seventeen times further than with it Hutton's experiments led him to believe that the resistance of the air increased a little more rapidly than the square of the velocity The French experiments have led to an expression involving the square and the cube of the velocity It is of the following form for spherical projectiles

$$\rho = 0\ 0005213\ \pi R v^2 \left(1 + \frac{v}{1426\ 4}\right) \frac{\delta}{534\ 3}$$

in which ρ represents the resistance of the air in pounds weight, π, the ratio of the circumference to the diameter, R, the diameter of the projectiles in feet, v, the velocity in feet per second, and δ, the density of the air at the time of observation For ordinary purposes $\frac{\delta}{534\ 5}$ may be taken as unity

For elongated projectiles, the co-efficient 0 0005213 = A is replaced by 0·0003475, but in some instances the former co-efficient has been found to be the most correct even for elongated projectiles

The resistance of the air gives rise to a ballistic co-efficient C, peculiar to each projectile

This is calculated from the formulæ

$$C = \frac{1}{2g} \frac{P}{A\pi R^2} = \frac{2}{3} \frac{R D}{g A}$$

in which g, A, π, R, are the same as before, P, weight of projectile in lbs, D, the density of the projectile, and A, its appropriate value, according as the projectile is spherical or elongated The co-efficient C is one of the data required in finding the multipliers B (a point), D, &c, used in the formulæ for the trajectory in the air

Colonel Majefsky, of the Russian Artillery, has proposed a formula involving the square and the fourth power of the velocity, which is said to give results even closer to practice than the French formulæ above detailed

The following short table, calculated by the formulæ, will give a notion of the amount of the resistance of the air

Velocity of Projectiles	Resistance in lbs Avoir. 24-Pr Shot	12-Pr Shot	Musket Bullet	10-Inch C Shell
1,600 feet	479	302	7	
1,400 "	343	216	5	
1,200 "	234	147	3	
1,000 "	150	95	2	462
800 "	88	56	1	271
600 "	45	28	0 7	139
400 "	18	11	0 3	56

On examining the above, it appears that the resistance decreases very rapidly with the velocity.

In effect, at a velocity of 800 feet, the resistance is less than one-fifth of that corresponding to the double velocity of 1,600 feet. Comparatively to the 24-Pr round shot, the resistance to the 12-Pr ,,one half its weight, is only about two-thirds of the former, that to the musket bullet, weighing $\frac{1}{384}$th of the same round shot, is but the 68th part. The 10-in common shell, weighing nearly four times as much, meets with a resistance which is only three times that of the 24-Pr, despite the inferiority of its density

At a velocity of 1,600 feet per second, the resistance opposed to the 24-Pr shot is 479 lbs, or twenty times its own weight, at a much smaller velocity of 600 feet per second, the resistance to projectiles is still in proportion to their weight, thus, nearly double for the 24-Pr, more than double for the 12-Pr, nearly ten times for the musket bullet, and nearly half as great again for the 10-in shell

Alarm Gun — Formerly, three guns were placed in front of a camp, 100 paces from the artillery posts, ready to be fired, as an alarm to the troops, in case of a sudden attack by the enemy

Alarm-Post—A place told off on the arrival of a force into a new quarter, camp, or bivouac, where the men are to repair in case of any sudden alarm by day or night The parade is generally looked upon as the alarm post, officers and men should proceed there ready armed, on the alarm being sounded, but if, in the case of a battery, the alarm should be "to horse," all must form mounted, and fully accoutred as for a march It is ordered in the Queen's Regulation that although a regiment or a division may remain for a single night only in a quarter, yet an alarm-post is invariably to be established, and the non-commissioned officers and men are to be made acquainted with it.

Alarms, False—Are stratagems of war frequently made use of to harass an enemy by keeping him perpetually under arms A vigilant officer will occasionally make a false alarm to try if his guard are on the alert. A fearful or negligent sentinel will create one by false reports

Alcohol—A term of Arabic origin, implying the pure spirit obtained by distillation from all liquids which have suffered the vinous fermentation. Alcohol is transparent, colourless, and inflammable It unites easily with resins, camphor, antimony and volatile oils It is known as "spirits of wine." Its specific gravity on becoming absolute alcohol is from 796 to 800, and it boils at 176°. It is used in the preparation of laboratory stores, such as fulminate of mercury, quick-match, and as a shell-lac to form varnish for percussion caps, &c

Alder (*Rhamnus Frangula*) — A tree, the charcoal of which is made use of in England for gunpowder. The common alder seldom exceeds forty feet in height, and is very durable under water.

Alert—An expression used to put soldiers on their guard, and to keep them vigilant It is likewise used by a post which may be attacked in the night, to give notice to the one that is destined to support it, and by a sentinel to give warning when any part of the enemy is approaching Thus, "we have had an alert" is a military phrase.

Algebra—Literal arithmetic, or the science by which quantity and the operations of quantity are expressed by conventional symbols.

Alien—Generally speaking, implies a person born in a foreign country, not

within the Queen's dominions, in contra-distinction to a denizen, or natural-born subject. But if the father were a natural-born subject, then the offspring would be so to all intents and purposes

Alignment—In military exercise, is the imaginary straight line that lies between any two given points, on which a line may be formed; or the pivot flanks of a column dressed

Alkali—A soluble body, with a hot caustic taste, which possesses the power of destroying or neutralizing acidity The term is derived from the Arabic article, *al* and *kali*, the Arabic name of a plant, from the ashes of which one of the most important alkalies (potash) is obtained

Allegiance — The obedience which every subject owes to his lawful sovereign or country This allegiance is binding on a British subject wherever he may go, and by no act of his own can he throw it off There is also a temporary allegiance which a foreigner owes to the sovereign within whose territories he resides

Alloy—The combination of one metal with another, except when mercury enters into the compound, which is then known as an amalgam

The following constitute the alloys of various metals

Bronze gun-metal, 90 5 copper and 9 5 tin
Bell-metal, 3 copper and 1 tin
Fine Brass, 2 copper and 1 tin
Sheet Brass, 3 copper and 1 zinc
Fine Solder, 2 tin and 1 lead
Coarse Tinner's Solder, 1 tin and 2 lead
Plumber's Solder, 1 tin and 1 lead
Pewter Solder, 4 zinc and 1 lead

The following alloy, which expands in coating, is useful for filling small cavities in cast-iron

9 lead, 2 antimony, 1 bismuth.

Altitude—In astronomy, the altitude of an object is its perpendicular distance from the ground or the plane of the horizon.

Alum—A double salt of great use in the Arts, especially to dyers, as well as to chemists and artists A solution of alum has an acid re-action, and a sweetish astringent taste The constituents of alum are sulphuric acid, alumina, an alkali, and water. The alkali may be potash, soda, or ammonia. Hence there are three distinct kinds of alum, depending on the alkali employed. Potash alum is the kind most in use

Ambulance—A conveyance for the sick of a regiment, and introduced into India a few years ago It is not intended that it should supersede the light and easy stretcher, termed a *dhoolie*, which is carried on the shoulders of natives, and which has hitherto formed the best conveyance for the sick and wounded on the field of battle, or in time of illness Ambulances answer very well for made roads, but across country they are anything but easy, and difficult to move They are so far convenient that they carry all the appliances for field surgery

Ambuscade—A snare set for the enemy, either to surprise him when marching without precaution, or by posting yourself advantageously and drawing him on by different stratagems, to attack him with superior force

Ambush—A detachment of troops placed in concealment for the purpose of surprising and attacking an enemy.

Ammunition—This term is applied not only to the charges of powder for ordnance and small arms, but it also includes all kinds of projectiles used in the service, and the various appliances for igniting the charges, &c.

Amnesty—An act of oblivion, or

forgiveness of past offences Usually an act of amnesty is meant to comprehend a number of individuals guilty of offences of a political nature, as rebellion, &c

Amplitude—In gunnery, the range of the shot, or the horizontal right line which measures the distance it has passed

Analysis—In chemistry, implies the resolution of compound bodies into their components, and is distinguished as proximate or ultimate analysis, according as the substance under examination is resolved into its proximate constituents, or into its elements In mathematics, analysis, or the analytic method, assumes the truth of the proposition to be proved, and then reasons backward until it arrives at some known truth Analysis is the reverse of synthesis, and therefore when any truth has been investigated by the analytic method, the proposition may be proved directly by inverting the process

Anchor—An iron instrument composed of a long shank, having a ring at one end, to which the cable is fastened, and at the other branching out into two arms or flukes, tending upwards with hooks or edges on each side, its use is to moor transports, boats, and rafts It is also a good hold for a capstan

Anemometer—An instrument for measuring the force or velocity of the wind The most common form of anemometers is that by Dr Whewell and N S Osler

Aneroid—A form of barometer invented by M Visti, of Paris Its action depends on the effect produced by the pressure of the atmosphere on a metallic base, which has been exhausted of air, and then hermetically sealed An index, traversing on a dial, records the changes in the weight or pressure of the air on a given surface

Angle, Acute—Is that which is less than a right angle

Angle of Clearance — In gunnery, is the angle of elevation, obtained when the tops of the tangent scale and dispart sight, and the notch on the muzzle, are in line

Angle, Dead—In fortification, any angle of a work, the ground before which is undefended by a flank fire.

Angle of Departure — In gunnery, the actual angle which the shot's path on leaving the muzzle of a gun makes with the true horizon This, when there is windage, may differ sensibly from the *angle of inclination*, and appears also to do so in the lighter rifled guns, where the shots are observed to rise, from the muzzle being slightly thrown up

Angle of Depression — In gunnery, the angle given to a piece of ordnance when laid under metal, or at an angle below the horizon

Angle of Descent—In gunnery, the angle which the tangent to the trajectory makes with the horizon at the height of the crest of the parapet, or other object to be cleared It is rather less than the terminal angle.

Angle of Elevation — In gunnery, the angle between the axis of the gun and the visual line from the sight on the tangent scale to the object It has no reference to the horizon or to any natural level

Angle, Flanked—In fortification, the angle formed by the flank of the bastion and curtain

Angle of Incidence — In gunnery, the angle which the tangent to the trajectory makes with the actual surface struck at the point of descent

Angle of Inclination — In gunnery, the angle which the axis of the

gun forms with the true horizon, or the angle shown by a correct spirit-level This is, consequently, the angle recorded when guns are laid by the quadrant

Angle, Obtuse—Is that which is greater than a right angle

Angle, Right—Is that which is made by one line perpendicular to another, it is always 90°, or the quadrant of a circle

Angle, Salient — In fortification, the angle formed by two lines of works meeting and pointing towards the country

Angle, Shoulder—In fortification, the angle formed by the face and flank of a bastion

Angle, Terminal—In gunnery, the angle which a tangent to the trajectory forms with the horizontal plane at the point of descent

Angle of Traction — In draught, the angle which the plane of the traces makes with the road on which the carriage is moving Artillery carriages having sometimes to move over the worst description of roads, the angle of traction must be slightly inclined upwards, as the vertical component of the pull will then assist the the wheels to surmount obstacles, the weight being transferred to the shoulders of the horse, increases the pressure of his feet upon the ground and gives him a firmer hold, thus enabling him to exert with ease a stronger pull, while the resistance against which he contends is at the same time diminished

Angular Velocity — Is the velocity of a body rotating round a fixed point, and is measured by the circular arc described by any point of the body at some unit of radial distance, usually one foot from the axis of rotation The velocity of any particular point of a rotatory body may be found by multiplying its angular velocity by the radial distance of the point from the axis of rotation; and *vice versâ*, the angular velocity may be found by dividing the velocity of any known point by its radial distance

Anna—An Indian term, expressing the sixteenth part of a rupee, generally, in India, applicable to the sixteenth part of anything

Annals—A species of military history, wherein events are related in the chronological order in which they happened They differ from a perfect history in being merely a relation of what passes every year, as a journal is of what passes every day

Annamally — The name of a forest in the southern part of India, which yields good teak timber, which is made use of for ordnance purposes in the Madras Presidency

Annealing—Is the process employed for softening certain malleable metals, which, under the action of the hammer or of the roller, have gradually increased in hardness, elasticity, and in density, from the close approximation of their particles Articles of iron and steel are sometimes annealed by piling them in an open fire and raising them slowly to a red heat, they are then left to cool gradually This method is injurious, on account of the oxide which forms on the surface, thereby depriving the steel of a portion of its carbon Articles of iron and steel ought to be annealed in close vessels, and covered up with ashes or clean sand, and, after arriving at a red heat, should be allowed to cool without letting in the air In annealing articles of iron or steel, they lose their brittle character, so that they can be bent without breaking The opposite effect takes place in annealing cop-

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per, which becomes brittle and hard Annealing has the property of imparting to axle-trees, after being much in use, renewed durability, and also of restoring iron, when crystallised, to its fibrous state

Anthracite Coal—A non-bituminous coal containing from 80 to 90 per cent of carbon South Wales abounds in it This coal is extensively used in smelting forges, and for steam engines, where freedom of smoke is required In gunpowder factories, on this account, it is commonly used either alone or mixed with bituminous coal

Anti-Corrosion—A paint used in coating ordnance, it has been superseded by Pulford's magnetic paint

Antimony—A metal of a grey or leaden colour, and very brittle It is found in mines with *galena*, or the sulphuret of lead, from which it is easily distinguished, the antimony occurring in fine streaky fibrous crystalline masses of a radiated texture, whereas sulphuret of lead is of a smooth, shiny, laminated nature It is found in Cornwall, France, Spain, Borneo, Nepal, the Straits, and Siam, and is commonly associated with iron, zinc, quartz, silver, sulphate of baryta, and carbonate of zinc It fuses at about 800° Faht, and volatilizes very perceptibly at a somewhat higher temperature It is one of the ingredients used in the detonating composition of friction tubes, and stars for signal rockets When mixed with lead, it has the property of hardening bullets Sulphide of antimony enters into those compositions employed to give a strong light. It is particularly well suited for that purpose, for being decomposed at a comparatively low temperature, the metal is set free and disseminated through the flame in a state of incandescence, causing the intensity of the light to be considerable, moreover, the heated particles coming in contact with the atmosphere, are thereby oxidised, forming a white smoke which is very favourable to the reflection of light.

Anvil, Smith's—Is a block of iron, having a rectangular-shaped face It is used by blacksmiths in the process of hammering malleable metals Anvils are sometimes made of cast-iron, but when required to be very hard or bright, they are made of wrought-iron and faced with steel The parts of an anvil are, the edge, face, pane or steel-cap, foot, and stock Anvils have usually a conical end, which is used for turning pieces of iron into a circular form The smith's anvil is generally placed on a loose wooden block, but the more firmly the anvil is connected with the earth, the more effective will be the blow of the hammer

Anvils, Tinman's — Are of several kinds, known as stakes and teests, for giving angles or proper corners to the tin plates.

Apex—The top or highest point of a cone or pyramid

Aphelion—Is that point of the orbit of the earth, or of any planet or comet, which is farthest from the sun

Apogee — Is that point of the moon's or a planet's orbit which is farthest from the earth

Apparatus, Manby's — Is used for communicating with wrecked vessels It is fired from a mortar

Appointments, Officer's—Usually imply military accoutrements, such as belts, sashes, swords, &c

Appointments, N. C. Officer's—In the mounted branch, consist of accoutrements, saddle, &c.

making a total weight, with the N C O, for the horse to carry, of 18 stone 13 lbs.

Approaches—All works are generally so called that are carried on towards a place which is besieged, such as the first, second, and third parallels, the trenches, redoubts, places of arms, saps, galleries, and lodgments

Appui—*Vide* Point d'appui

Aprons, Gun—Are usually of three kinds, lead, canvas, and tarpaulin, and are used to cover the vent and tangent blocks of ordnance Lead aprons are used for the vents of guns in position, canvas, chiefly for covering the vents and vent slots of field guns, and tarpaulin aprons for the vent slots of 110-Pr, 40-Pr, and 20-Pr guns

Arc—The segment of a circle

Area—The measure of the space or surface contained within the boundaries of any plane figure, as a triangle, which is calculated by the number of small squares that may be contained in it, the side of these measuring squares being an inch, a foot, or any other fixed quantity

Arithmetical Progression—Quantities are said to be in arithmetical progression, when they increase or decrease by a common difference, thus a, $a + d$, $a + 2d$, $a + 3d$, &c, is an arithmetical series, whereof a is the first term and d the common difference If n be the number of terms, l the nth term, s the sum of n terms, then $l = a + d\ (n - 1)$, $s = \frac{n}{2}\ (a + l)$

Arm—Signifies any particular description or class of troops Used figuratively, denotes power

Armament—A force equipped for war, a term also given to the guns of a fortress or ship The armament of a fortress depends upon the size and description of the works, as well as the nature of the locality on which they are situated, but no fixed proportion has yet been definitely settled Since the introduction of rifled guns, the following will probably form the armament of a fortress,—*viz*, the 40-Pr, B L Armstrong gun, and the 7, 9, 10 and 12-inch M L rifled guns The 10-inch shell gun and all the natures of 8-inch guns may be employed with advantage; the 8-inch gun of 6 ft, as well as the 10 and 8-inch howitzers and the 32-Pr of 25 cwt., being used for flanks and short ranges Mortars also should form part of the ordnance of a fortress, being useful in annoying the working parties of besiegers In addition to the above, field-pieces will be required for the defence of covert ways, sorties, &c

Armistice—A truce or suspension of hostilities

Armour, Body—A defensive habit formerly worn for the defence or protection of the body Complete armour anciently consisted of a casque or helm, a gorget, cuirass, gauntlets, tasses, brassets, cuisher, and covers for the legs, to which the spurs were fastened This formed armour "*cap-à-pie*," and was used by the cavaliers and men-at-arms. The infantry had only part of it,—*viz*, a pot or head-piece, a cuirass and tasses, but all light. Body armour at the present day is confined to a few regiments of heavy cavalry, and consists of the cuirass and helmet only In oriental armies, chain armour is partially retained

Armour Plating—The system introduced into the Navy for the purpose of protecting ships of war against the fire of artillery The project of covering wooden ships with iron plate was first suggested, many years since (1821) by Colonel, the late General Paixhans, but it led to no attempt

France to cuirass ships of war, and the project was at that time abandoned In 1854, however, the idea was reproduced in France by Napoleon III, who then proposed the construction of floating batteries, or ships protected on the exterior by thick plates of iron, which led to the building of the French frigate *La Gloire* In England, experiments on the subject also engaged the attention of the Government, as early as the years 1849 and 1851 , and since then further experiments have been carried on, as to the proper thickness of iron to be given to ships of war, and the form of ship, with reference to the increased power of artillery The result is, that some of our ships of war have now a coating of 9 inches of iron, with a wooden backing of from 10 to 12 inches Such ships are the *Hercules* and the *Sultan*, both broadside ships, having the bulk of their armament, 18-ton guns (600-Prs), carried in a central battery on the main deck These two powerful vessels are capable of acting as "rams" also

Of the cupola system of ships, we have had, in the loss of the *Captain*, a sad example of the danger of rigging such ships as sailing vessels, and expecting them, with their low free-boards and top weight, to overcome every weather, for, though the *Captain* is the first instance of this class of ship foundering from stress of weather, the top weight of this description of vessel is so great, that it may certainly be said to be more likely to founder than a cruiser would be

Not only has armour-plating been applied to ships, but to the construction of shields for the protection of the embrasures of casemates, forts, &c

Armourer—A skilled mechanic attached to regiments of infantry, cavalry, and arsenals, for the purpose of repairing and keeping the arms in order Armourers are also attached to Armstrong Batteries.

Armoury—A building specially provided in arsenals for the deposit and preservation of small arms An armoury should be very dry and well ventilated In a damp climate, a "dry room" would be a desirable adjunct, for, with every care and attention, rust will make its appearance if the outer air is not excluded

Arms—Instruments of different forms and natures, for attack and defence The manufacture of arms is of very ancient date, coeval with the world Necessity drove men to make them either in defence of themselves against wild animals or against their enemies The arms used by the ancients comprised a variety of kinds, such as the spear, the lance, the hatchet, the battle-axe, the bow, and several others , and though these arms were in many instances rude and unwieldy, the treatment of iron seems to have been well known , and in steel they were great adepts, as the blades of Damascus testify, which were famed throughout the world Also in India, from a very early date, the tempering of steel has been well known

The arms of the present day in the British service, vary according to the branch of the army in which they are used In the Infantry, the converted Enfield (Snider rifle) is at present the general arm of the service, but it will shortly be superseded by the Martini-Henry rifle In the Cavalry, the sword, lance, carbine, and pistol, according to their respective services , the Dragoon Guards, Dragoons, and Hussars being equipped with the carbine and sword, the Lancers, with the sword and lance. In the Artillery, the following arms are

provided, to a battery of horse artillery, a sword to each man of all ranks', and twenty-four carbines are attached to the battery for sentry duties to a battery of field artillery, a sword to each non-commissioned officer, artificer, or trumpeter, and to all gunners a sword bayonet, with twenty-four carbines per battery Heavy field batteries are similarly equipped Garrison batteries, all ranks, except trumpeters, are furnished with a complete stand of arms, the trumpeters (and artificers, if any) having a sword bayonet

Armstrong Gun—*Vide* Gun

Army—An organised and disciplined force of armed men for military service, commanded by a chief or leader, with officers of all ranks in subordination to him Modern European armies consist of the following arms Artillery, Cavalry, Engineers, and Infantry The relative proportion of each arm varies, within certain limits, in different armies An army permanently maintained constitutes the standing army of a country, and is commanded by a general officer whose title is that of Commander-in-Chief Armies in the field are primarily divided into *corps d'armée*, comprising all arms, each under a marshal or general officer, each *corps d'armée* is subdivided into divisions, which may or may not comprise all arms, and divisions into brigades The strength of a *corps d'armée* depends on the capability of the nation to furnish men, and the nature of the operations In the French and Prussian armies, the strength of a *corps d'armée* is from 30 to 40,000 men The strength of a division varies similarly, according to circumstances Except when acting independently, when it is virtually a *corps d'armée*, a division consists of one arm only A brigade consists of two or more regiments of the same arm, and is subordinate to a divisional command, and commanded by a Brigadier An army in the field to be effective, requires to be completely equipped with ordnance, commissariat, engineer, medical stores, and the means of transport. The supply of these necessary concomitants of an army in the field demands the services of regularly organized departments, on the efficiency of which the success of the operations undertaken by the army depends The standing army of a country is generally supplemented by militia or volunteer forces

Arquebus—An ancient hand-gun The design was taken from the old cross-bow, its name conveying the meaning of 'bow with a mouth' On the formation of the English yeomen of the guard in 1485, one-half were armed with the *arquebus*, which had gunpowder for its motive power.

Array—Order of battle

Arrest — In a military sense, implies the suspension of an officer, for misconduct, from all military duty, until released by superior authority, or, if brought before a Court Martial, until he shall have proved himself innocent of the charge It is ruled in the Queen's Regulations that, before bringing an officer to trial, it is necessary that his conduct shall have been previously examined by superior authority, in order to ascertain that the charges are such as should be submitted to the cognizance of a Court-Martial, and that there is sufficient evidence to substantiate them.

Arsenal—A place of receipt and issue of ammunition, small arms, and all warlike stores The main arsenals in India are not on the gigantic scale of the Royal Arsenal at Woolwich,

which contains within itself several manufacturing establishments; but are, as described above, rather places of receipt and issue of ordnance stores, the Carriage, Gun, and Small Arm Factories being separate establishments All arsenals in India have workshops attached to them, but they are merely for effecting repairs—not so much for manufacturing stores

In India, an arsenal is under the charge of an Artillery Officer of the Ordnance Department, assisted by commissioned and warrant officers, together with a staff of non-commissioned officers and native workmen The duties of the commissioned, warrant, and non-commissioned officers attached, are detailed at length in the Ordnance Codes of the several Presidencies

Arsenic—A metal of a crystalline appearance, and imported into India from Burmah, China, and the Persian Gulf It sublimes at 356°, emitting a strong garlic smell during the sublimation If the process be performed with free access of air, arsenious acid is rapidly formed The arsenic of commerce is of a white colour, what is used in the laboratory is a sulphuret of arsenic, and is of two kinds—the native yellow sesqui-sulphuret of arsenic, called "orpiment," and the red proto-sulphuret or "realgar" Of orpiment, there are many varieties,—one in fine gold-coloured scales, another in intense yellow stony lumps; a third in earthy-looking masses, called the king's yellow, a familiar paint. For the use to which arsenic is put in the artillery service, *vide* "Orpiment."

Art—Military art may be divided into two principal branches The first relates to the order and arrangement which must be observed in the management of an army,—when it is to fight, to march, or to be encamped. This branch derives its appellation from *tactic*, which signifies order The same term belongs to the other branch of military art, and includes the composition and the application of warlike machines.

Articles of War—Are rules and regulations for the better government of Her Majesty's forces at home and abroad, which the Sovereign is empowered by the Mutiny Act to make and institute, under her sign-manual This privilege has been annually re-enacted, and annually exercised by the Crown since the reign of George III to the present day (*vide* Manual of Military Law, by Colonel Pipon) As the Articles of War are read at the head of every corps in the service once in three months, no individual can plead ignorance as an extenuation of misconduct

The Mutiny Act and Articles of War for the time being, tempered by the regulations issued from time to time by the Sovereign, form together the code of laws which governs the British Army

Artillery—The name given to ordnance of all natures, and the arm of the service entertained for their use It comprises also the art of manufacturing every nature of gun-carriage and ammunition, as well as the mode of preserving and making use of them Besides comprising the *materiel*, it includes also the *personnel*, of that arm The origin of artillery, if we take the term in its most extended sense, is of very ancient date, and we read that before the introduction of gunpowder, our ancestors used machines termed the balista, catapult, and battering ram, which projected stones and arrows for battering down the lofty walls and towers that were the defence of many of our old towns.

On the introduction of gunpowder, guns termed "bombards" were manufactured—rude specimens of the art as compared with later introductions—and they were at first principally hand-arms, weighing from 25 to 30 lbs, but were subsequently increased in size, and termed "cannon" The first guns were built up with wrought-iron bars or plates, strengthened with rings of the same material, they projected stones, and were fired from the ground, or from rough wooden beds, which served as carriages By degrees, and after some centuries, the calibres of ordnance were enlarged, and brass guns were introduced as early as the fifteenth century, towards the close of which, carriages with wheels were invented, showing what great strides were already made in all matters pertaining to ordnance,—and this chiefly in France This progress continued through the following centuries, when, in the eighteenth century, we find a foundry established at Carron in Scotland, where carronades were first made, and which gave the name to this nature of ordnance

At this foundry, as well as at Lowmoor in Yorkshire, most of our cast-iron guns have been manufactured These guns are already to a great extent superseded by rifled ordnance, though there are still many in the service

The *matériel* of the British artillery is divided into three classes,—siege, garrison, and field, comprising guns of all calibres, from the 12-inch rifled gun (600-Pr), to the 7-Pr mountain gun, including heavy howitzers and mortars

The *personnel* of the regiment, since its amalgamation with the artilleries of India, comprises a body of about forty thousand men of all grades, consisting of twenty-nine brigades,—*viz.*, five of horse artillery and twenty four of garrison and field, with two depôt brigades and a coast brigade. The strength of the field brigades, it is stated, is to be increased

The brigades consist in the aggregate of 97 batteries of 6 guns each, this includes the total of light artillery in the service at home and abroad,—the strength of each battery numbering, on an average, 150 non-commissioned officers and men

The total number of officers on the 1st of January 1871 was as follows —32 Colonels Commandant, 71 Colonels, 136 Lieut-Colonels, 577 Captains (1st and 2nd), 669 Lieutenants, 29 Officers of the Coast Brigade, 17 Riding Masters, 150 Medical Officers, and 16 Paymasters

Asphaltum or Asphalte—A bituminous substance somewhat allied to coal in its properties, and probably in its origin and mode of formation It is exceedingly inflammable, readily softened by heat, *and more or less soluble in alcohol*, ether, and oils It is employed in admixture with hard mineral substances, and with pitch as a material for paving and covering roofs and floors A black enamel varnish is also made of asphalte

Assault—To attack a fortified work, either by escalade, or on the breach being reported practicable For instructions on conducting an assault, *vide* Aide Memoire

Assault of Arms—Military exercises, comprised in the use of the broadsword, small sword, and bayonet exercise, as well as fencing.

Assembly—The second beating of the drum before a march, at which the men strike their tents, roll them up, and stand to arms.

Atmosphere—Is the general term applied to the whole gaseous portion of the earth. Being much

lighter than either land or water, it floats or rests upon them, and rises to the height of probably 40 or 50 miles above the level of the sea. It consists essentially of two gases, oxygen and nitrogen One hundred parts by weight contain 77 parts nitrogen, and 23 parts oxygen , or by measure 79 19 nitrogen, and 20 81 oxygen

The atmosphere is measured by a column of mercury of 29 922 inches, which has been adopted in France as the mean height of the barometer at the surface of the sea

Atmosphere, pressure of—The weight of the atmosphere with a barometric pressure of 30 inches is equivalent to 14 09 lbs on the square inch

Attack—In a general sense, means any assault upon an enemy In a siege it implies the works which the besiegers carry on, as trenches, saps, galleries, &c , in order to take the place by storm In attacking a position, a false attack is sometimes made at the same moment with the real attack, to divert the attention of the enemy, and to make him divide his forces

Attention—A cautionary word used in the British Army, as a preparative to any particular exercise or manœuvre

Attrition — The rubbing of bodies one against another, so as to destroy their surfaces

Auger, Carpenter's Spiral—A tool shaped like a gimlet, having a transverse handle, and used for boring large holes for bolts, &c

Augers are of different sizes, from 1½ inch to ¼ of an inch There are, besides, several kinds of augers, such as the single tip auger, the double tipped, the American screw auger, &c , also the common auger of sorts, which is a fluted instrument, to give room for the shavings.

Auget—A wooden trough for the saucisson of a mine

Auxiliary — Foreign or subsidiary troops which are furnished to a belligerent power in consequence of a treaty of alliance, or for pecuniary considerations

Austrian Field Gun—Is a muzzle-loading rifled gun made of bronze, a 4-Pr , having a projectile weighing 8lbs , the gun itself weighing a little over 5 cwt The projectiles are covered with zinc and tin, and the grooves in the gun may be said to be formed by wrapping a number of t i-angles round a cylindrical bore The following are the dimensions of the gun —

Calibre	3 17 in
Number of grooves	6
Depth	175 in
Width	1 54 in
Length of bore rifled	42 2 in
Pitch-angle	8° 30′
Length of bore	15 calibres
Weight of piece	5 177 cwt

Axe, Cooper's — A short flat iron instrument, having the handle running parallel to the sharp end of the blade It is used for thinning the staves and heads of barrels

Axe, Felling — An implement used for felling trees and jungle, and attached to movable batteries for clearing any impediments in their march

Axe, Pick—An implement used for levelling uneven ground

Axis—In gunnery, the axis of a gun is an imaginary line drawn from the breech to the muzzle. It will be better understood by imagining a gun supported in the lathe at its two extreme points, when a line drawn between these points will represent the axis of the piece

Axletree — A transverse beam supporting a carriage, and on the

ends of which the wheels revolve. Axletrees for artillery carriages in India were at one time always manufactured in the country, chiefly at the Gun Carriage Agencies, from material received from England, but ready-made axles have of late years been received from that country Flat bar iron, $3\frac{1}{4} \times 1$ inch, bearing the brand Govan B Best, is the most approved of During the process of manufacture, the iron is carefully annealed, and the axletree, on completion, tested according to the French mode of proof, which is effected by letting fall a weight on the axletree from a height of $4\frac{1}{2}$ or $3\frac{1}{2}$ feet, according to the nature of the specimen The machine used in testing axletrees is very similar to a pile-driving machine, and the weight of impact on the axletree is such, that any faults in the manufacture or quality of the iron are at once detected, either by flaws, fracture, or excessive bending of the axletree

Axletree arm—That part of the axletree which enters into the nave of the wheel It tapers from the shoulder to the end of the arm For information on the friction of axletree arms, *vide* Friction

Axletree bed—In an artillery carriage, the wooden bed into which the axletree is firmly fitted, in the gun carriage it is secured by bolts passing through the block trail It is further fastened to the brackets of the carriage by the axletree band, which passes under it, and also by bolts passing through the brackets, two of which have eye-pins, and fasten on the cap squares

Ayenee—(*Artocarpus hirsuta*) A tree which grows in the forests of Southern India, Godavery, and Burmah; the wood is strong, tolerably close, even-grained, and of a light yellowish colour It is a wood that may be used for gun-carriage purposes

Azimuths—In astronomy, called also vertical circles, are great circles intersecting each other in the zenith and nadir, and cutting the horizon at right angles in all the points thereof

B.

Babool (*Acacia Arabica*)—A tree which is found in every district of India The wood is close-grained and tough, of a pale red colour, inclining to brown It is used in the Gun Carriage Agencies of Madras and Bombay for naves and felloes of wheels

Badge—The term applied to the Royal Arms mounted on pieces of ordnance—(*Vide Marks*) The chevron worn by non-commissioned officers to distinguish their rank is also termed a badge (*Vide Chevron*)

Bags—In the military service, are used for a variety of purposes, but their number is so infinite that space will not permit of their being given in detail in this work, with the exception of those described below

Bags, Blowing—Contain the blowing charge for different natures of common shells when used for practice, and are a mixture of gunpowder and coal dust The blowing charge is not intended to burst the shell, but to blow out the fuze, to mark where the shell would have burst They are made, in India, of Doosootee cloth

Bags, Cartridge Waterproof—For holding small arm cartridges when dispatched to foreign stations They are made of waterproof cloth Cannon cartridges are packed in waterproof paper when specially asked for

Bags, Gunny—Are used with siege-trains for carrying charcoal, and are made of coarse gunny cloth.

Bags, Gunpowder—Are used for blowing open gates, stockades, &c. The size of the bags differs according to the charge intended to be placed in them, and they are fired generally by means of a Bickford fuze The bags are either placed on the ground, or fastened by a hook to the gate In Burmah, in 1852, experiments were made to test the value of powder bags in blowing down stockades, and the result proved most satisfactory ;—bags containing from 20 to 25 lbs of powder causing a rent large enough to admit of a section of infantry entering within the enclosure Experiments were also at the same time made with 8-inch howitzers, which failed to make much impression on this mode of defence

A late report on gun-cotton points to this material as being the most efficacious for the demolition of stockades, and indeed for many of the purposes which gunpowder has hitherto been used —*Vide* Gun-cotton

Bags, Sand—Made of coarse canvas, tarred or untarred, they are filled with earth, and used for reveting the interior slopes of field works, and to give cover to riflemen firing over a parapet, they are also used for other general purposes

Bags, Soldiers'—Are of two kinds, painted and unpainted, and are made of canvas or vitry cloth The painted bag contains the soldier's kit for the march, and is carried with the baggage The unpainted, or haversack, is slung over his shoulder, and is used by the soldier on the march to carry extra rations, or any spare articles he may have in his possession

Baggage—In a military sense, includes the clothes, camp equipage, and cooking apparatus of a regiment or army. The baggage of troops in India is conveyed either by the native cart of the country, termed a Hackery in the North-West, Gharee in Bombay, and a Bandy in Madras; or on the backs of elephants and camels, according to the part of India in which the troops may be In the North-West of India, elephants and camels (when off the line of railway) are almost exclusively used, and in Bengal, carts, but along the line of railroad, advantage is taken of it for the transport both of troops and baggage, except for Cavalry or batteries of Artillery, which in times of peace invariably march Carts vary in size in different districts, and are drawn by two, three, or four bullocks A four-bullock hackery, which in the North-West of India is generally the size used, will carry 20 maunds, or 5 maunds to every bullock An elephant can carry about 1,200 or 1,400 pounds, and a camel, 320 lbs, the usual length of march, without being distressed

Bagpipe—The name of a well-known warlike instrument, used only in the army by Highland regiments It is supposed to be of Grecian origin, and the Romans, in all probability, borrowed it from the Greeks The natives of India have an instrument very like the bagpipe

The bagpipe has long been a favorite instrument with the Scots, inspiring them with great enthusiasm and valor in the day of battle

Baldric—A belt worn in ancient times by officers, and from which the sword was hung

Balista—A machine used by the ancients before the invention or introduction of gunpowder It projected masses of stone to a distance of 90 yards Darts and arrows were also thrown from the balista.

Balk or Baulk—Light beams used in the formation of a pontoon or boat-bridge.

Ball—Any round substance of iron or lead discharged from cannon or small arms. The first balls for cannon were generally made of stone Cast-iron was subsequently used, of a spherical form Since the introduction of rifled cannon, oblong shot are projected from this nature of ordnance

Ball Cartridge—Ammunition used with the several natures of small arms in the service For the Snider or Enfield rifle, the cartridge contains 2½ drs of powder (R F G) The artillery rifle cartridge has only 2 drs

Ballistic Pendulum—Essentially, is a mass of some convenient material suspended like a pendulum, into which a piece of artillery is fired, so that its shot shall strike centrically and cause the pendulum to vibrate through a given arc It was the invention of Robins, and has been, since his time, improved by Hutton, Piobert, and other scientific artillerists In its more modern and improved form, it consists of a conical cast-iron vessel termed the receiver, suspended on an axle with knife-edge ends by means of four wrought-iron bars, two of which enclose the front, and two the rear of the receiver A number of discs of lead are carried on a rod below the receiver, with a screw-thread cut on it, and thumb screws By this means the centres of gravity and oscillation may be altered at will, and the axis of the receiver made truly horizontal The hollow or bore of the receiver is shaped as a truncated cone, rounded at the bottom, and of a length such that the projectiles cannot pass completely through the sand with which it is tightly rammed To make an experiment, a barrel, truncated cone in shape, and filled with sand tightly rammed, is put into the receiver, its front is then closed by a thin sheet of lead. The object of the lead is to give the centre of impact, and to prevent the escape of the sand or pieces of the barrel an arc of a circle divided to minutes, and having a slider carrying a vernier, is fixed below the pendulum, but only connected to the pendulum by a needle which drives the slider as far as the pendulum vibrates, and leaves it there The gun is suspended in a manner almost similar The ballistic and gun pendulums are supported by piles of masonry, so that the muzzle of the gun is 12 yards from the face of the receiver At a couple of yards from the muzzle of the gun is a short wooden screen, with a hole a foot and a half in diameter cut into it This arrangement prevents the blast of the powder, or any other portion of the charge than the shot, from affecting the receiver If V be the velocity sought, P the weight of the pendulum, b that of the projectile, G, K, i, the respective distances to the edge of the knife-edges of the centre of gravity of the pendulum, of the oscillation, and of the point of impact A, the angle of recoil of the pendulum, g, the force of gravity, $P\ G$ the statical moment of the pendulum, R the radius of the arc on which A is measured, and C the chord corresponding to A, then—

$$V = \frac{\sqrt{PGK \times bi2 \quad (PG \times bi)g}}{bi} 2 \sin \tfrac{1}{2} A$$

2 sin ½ A may be replaced by $\frac{C}{R}$

The ballistic pendulum has been advantageously replaced by Navez Leurs' ballistic apparatus

Ballistics—Is the science of the motion of projectiles. By this science all problems that can be imagined with reference to the flight of spherical and

oblong shot or shell are resolved It is divided into two distinct parts, according as to whether the projectile is supposed to fly through empty space, or through the resisting medium of the air The calculations based on the former hypothesis are found to tally with the results of practice with shells of large calibre fired with small initial velocities, and consequently short ranges The trajectory is supposed to be a parabola, and the curve of the actual trajectory of shells fired under such circumstances, or of the steel ball of the eprouvette mortar, differs but little therefrom, when the velocity increases, on the other hand, the formulæ of the parabolic system have to be altered by certain co-efficients, which have to be calculated in each case, but with great ease, with the assistance of the published tables of the French Artillery by General Didion Problems worked out with these altered formulæ give results approaching so closely to those of actual practice, as to leave but little to be desired

Trajectory in Vacuo

If V be the initial velocity, *h* the height due to that velocity, ϕ the angle of projection, *x* and *y* the horizontal and vertical co-ordinates of the centre of the projectile starting from the origin, *v* the velocity at the point, *a* and *b* horizontal distance and vertical height of the object, ϵ angle of elevation of the object (positive or negative, according as the object is above or below the muzzle of the piece)

Tan $\epsilon=\frac{b}{a}$ X amplitude of the trajectory on the horizontal plane, Y the height of projection, T total duration of motion, *g*, expressing the force of gravity, $h=\frac{V^2}{2g}$ or $v=\sqrt{2g\,h}$, $V\cos\phi$, horizontal projection of the velocity or the horizontal velocity, V, *sin* ϕ, vertical projection of the velocity

$$y=x\tan\phi-\frac{g}{2}\,\frac{x^2}{V^2\cos^2\phi}$$

$$=x\tan\phi-\frac{x^2}{4h\cos^2\phi},$$

$$y=Vt\sin\phi-\tfrac{1}{2}gt^2,\ x=Vt\cos\phi,$$

$$v=\sqrt{2g(h-y)}$$

$$t=\frac{x}{V\cos\phi},\ T=\frac{V\sin\phi}{\frac{1}{2}g}$$

$$=2\sin\phi\sqrt{\frac{2h}{g}}$$

$$Y=\frac{V^2\sin^2\phi}{2g}=h\sin^2\phi,$$

$$X=\frac{V^2}{g}\sin 2\phi=2h\sin 2\phi,$$

$$\operatorname{Tan}\theta=\tan\phi-\frac{a}{2h\cos^2\phi},$$

$$\operatorname{Tan}\phi=2\tan\epsilon-\tan\theta,$$

$$V=\frac{1}{\cos\phi}\sqrt{\left(\frac{g}{2}\,\frac{a}{\tan\epsilon-\tan\theta}\right)}$$

Trajectory in the Air

The formulæ only differ from the above in that they involve the co-efficients B, I, D, and U, the values of which are to be found in the excellent tables of Didion, the use of which becomes very easy after a little practice

$$y=x\tan\phi-\frac{g}{2}\,\frac{x^2}{V^2\cos^2\phi}B,$$

$$\tan\theta=\tan\phi-g\frac{x}{V^2\cos^2\phi}I,$$

$$t=\frac{x}{V\cos\phi}D,\ =\frac{V\cos\phi}{U\cos\theta}$$

When the inclination of the trajectory is not greater than 3°, V *cos* ϕ may be replaced by V. With regard to mortar practice, at considerable distances, another factor, having reference to the

radius of curvature, is involved, regarding which the reader is referred to Didion's work on Ballistics

Of the above co-efficients, the three multipliers refer—B, to the fall of the projectile, I, to the inclination of the trajectory, D, to the duration of flight, and the divisor U to the velocity *Vide* Air, Resistance of

Balloon—A hollow silken vessel filled with gas (hydrogen), which, being lighter than air, causes the balloon to rise Balloons of a large size are used for scientific and military purposes Messrs Glaisher and Coxwell made several ascents in England in 1862 (upwards of five miles), with the view of ascertaining certain meteorological points It appears from the description given of their voyages, that the air at the height of five miles is so rarefied as to render human existence precarious The barometer showed at this height 11 inches, and the thermometer 2° below zero of Faht Balloons are used in warfare for purposes of reconnoitring, and in the case of a beleaguered city, for keeping up communication with the outside world (*Vide* the accounts of ascents from Paris in 1870)

The Prussians are said to have reconnoitred the French position before Metz in the war of 1870 by means of a balloon with telegraph attached, and it is further said that the survey, made with great care, was most successful, and conveyed instantaneously to General Von Moltke the true position of the French army at all points, and its movements

It will be interesting at the present time to learn the results of experiments made at Woolwich in reference to war balloons inflated at the Royal Arsenal gasworks, which are thus described —

"It has been found that a height of 100 fathoms, at a horizontal distance of 600 fathoms from the enemy, would enable the observers to secure the widest expanse of view With captive balloons it has been found that they attain stability, and remain like a kite, at rest, when the horizontal resultant of the ascensional force, and the tension of the cord, are equal to the force of the wind, and this enables a second diversion of science to come in and lend its aid in the time of war The war balloon having, by a mathematical rule, taken a stationary position, eight cameras and lenses, spread round the balloon at equal distances, enables a complete view of the surrounding country to be photographed, and subsequently examined at leisure The inclination and length of the cord to keep the balloon in the same stratum of air was found to be easily calculable, subject to the inequality of gales of wind and their change of direction The Woolwich balloons were held by two new cords, fastened to the network, and terminating at two different points on the ground, which gave greater stability to the balloon, and provided against one cord snapping or being cut by the enemy's fire Under the old plan, aeronautic correspondence was carried on by the explorers in the balloon car being provided with white pasteboard tubes, formed like cartridges open at both ends, to which a bullet was securely fastened Each piece of intelligence was written in pencil in large characters along the major axis of the paper tube or cartridge, which was immediately despatched by passing the end of the small cord through it, and it was thus precipitated by the gravitation of the bullet into the hands of the expectant general This plan has just been abrogated by a third diversion of science being brought to bear in the time of war. By the new

system of military telegraphy for field service, and by means of the wagons at present being placed in store in the Royal Arsenal, lines of telegraph can be carried through the air from *terra firma* to a balloon several miles distant. The wire can be paid out as fast as the balloon travels, so that if a captive balloon should break or soar away, communication could be kept up with it for six miles, or two or more balloons can be sent"

A very amusing account is given, in a number of the *Pall Mall Gazette*, of the first balloons used for war purposes The first proposal for employing what were then termed captive balloons, was made by the Committee of Public Safety in 1793 After some preliminary experiments at Meudon, a small corps of aerostats, skilled in precarious crafts, was formed on the model of an engineer company, and despatched to Manberg, then besieged by the Dutch and Austrian troops The balloon used was thirty feet in diameter, and rose 1,800 feet with two observers and 130 lbs of ballast It was managed by two ropes attached to the net, and was filled with hydrogen, obtained with much difficulty and expense from water The immediate moral effect upon the enemy of the use of this balloon by the besieged was extraordinary They imagined, which was far from being the case, that their every movement was at once made patent to the French, and it was this that in a great measure caused the demoralised Austrians to abandon the siege The balloon, passing from a defensive to an offensive position, was then transported while inflated to Charleroi, which the French were attacking

Its apparition at once deprived the besieged of all confidence in their strength, and hastened the surrender of the town while still efficient for defence The balloon was subsequently used at Fleurus, where much is attributed to it, then at Brussels, Liege, Aix-la-Chapelle, on the Rhine, and on the Danube

A corps of aerostats also accompanied the French army to Egypt, but did nothing, as the apparatus was damaged on the way In 1800 both corps were suppressed

The Prussians used ballooning against the French in 1812, but the results were not encouraging At Solferino, one of the brothers Godard ascended in a 'Montgolfier', but he was much too late, and the ascent was all but useless In the American war, too, balloons were used from time to time, but they were attended with no advantage

Balloon Shells—Are spherical tin cases, over which paper is pasted, until the shell is of the required size

These shells are well adapted for signals, as they can be thrown from 5½ inch mortars at an angle of about 85°, with a charge of seven ounces of powder, and on their bursting they show a brilliant light of great size and of considerable duration They have been superseded by the Parachute Light Ball

Bamboo (*Bambusa*)—Is a genus of grasses, of which it is the most gigantic, it is well known for its great economical importance It is found in all tropical climates, and the purposes to which it is applied are so numerous that it would be difficult to point out an object in which strength and elasticity are requisite, and for which lightness is no objection, to which the stems are not adapted in the countries where it grows When ripe and hard, it is converted into bows, arrows, and quivers, lance-shafts, poles of palanquins, poles for tents, fire and escalading ladders, the floors and supporters of rustic

bridges In an artillery park it is useful for carrying weights, such as ammunition boxes, shot or shell when carried in slings, and for a variety of similar purposes

Band — A name formerly given to a company of soldiers The word is applied also to a body of musicians attached to each regiment As stated in the Queen's Regulations, a band of music is essential to the credit and appearance of a regiment, and every officer (married or single) has to pay for its maintenance The regimental band is to consist of a sergeant and twenty rank and file in the infantry, and fifteen privates in the cavalry In the regiment of artillery, in consequence of its greater strength, the band has increased numbers, and remains always at Woolwich, the headquarters of the regiment Bandsmen are liable to serve in the ranks on any emergency

Band—Any thing bound round another In artillery material, certain parts of the iron work of carriages are termed bands, such as the axletree, nave, splinter bar, and shaft bands The axletree bands secure the axletree and its bed to the carriage, the nave bands tend to keep the nave from splitting or splits from enlarging, the splinter bar bands (four in number) connect the shafts with the splinter bar, and the shaft bands secure and strengthen the extremities of siege shafts

Bandoleers — Small wooden cases, covered with leather, twelve in number, each containing a round of ammunition, which used to be worn by musketeers in former days, attached to the shoulder-belt They are now obsolete, though at the present day sportsmen wear waist-belts with so many detached charges hanging to the belt

Bandrol or Bannerole—A small flag Bandrols are used to convey signals from any particular spot to a saluting battery or other post Also to mark the position to be taken up by the flanks of a regiment at a review, in deploying, &c

Bandy—An Indian name for a Madras country cart

Banner — Formerly, a flag or standard under which the vassals of the lord of a manor united for some common purpose, he being the chief of the troop or company The word is in disuse at present in the army, except for the small flags attached to the drums and trumpets of cavalry regiments

Banquette — A step of earth about 4½ feet below the crest of the parapet, to enable the shortest men to fire over it with facility

Bar Bells—Used for gymnasia, and are of the following weights 20 lbs, 35 lbs, and 40 lbs

Barbette — An earthen terrace raised within a parapet, so high as to enable guns to fire over the crest of the latter, and, therefore, with a freer range than when worked at an embrasure

Barbican—A watch-tower, having a considerable command of view, and admitting thereby of the enemy being seen at some distance It also implies an ancient fortification placed before the walls of a town, or a defence at the entrance of a bridge, also, apertures made in the walls of a fortress, to fire through upon the enemy

Bar Iron—Is malleable iron, and either square or flat Bar iron should be tested by the fracture, and the sample should be inch square, or, if flat bar, ½ inch thick To carry out the test, cut a notch on one side with a cold chisel and bend the bar down over the edge of an anvil, or give

it a heavy blow, when lying flat on the ground, with a sledge hammer , if the fracture exhibits long silky fibres of a leaden grey color, cohering together, and twisted, or pulling apart before breaking, it denotes a tough, soft iron, which is easy to work and hard to break, suitable for sheet iron, wire, &c , but it may weld badly A medium even grain, mixed with fibres as above, but without white specks or dark spots, is also a favorable indication , in general, a short blackish fibre indicates iron badly refined and mixed with carbon, plumbago, or oxide , if worked very hot, it may be improved, but there will be great waste A very fine close grain denotes a hard steely iron, which is apt to be "cold-short," hard to work with hammer or file A coarse grain with a brilliant crystallized fracture, or yellow or brown spots, denotes a brittle iron, inclined to be "cold-short," but working easily when heated, and making a good weld Cracks on the edges of the bar generally indicate a "hot-short" iron which will not weld Blisters, flaws, &c , are caused by imperfect welding at too low a heat, or by the iron not being properly worked, but do not always indicate an inferior quality In general, good iron is readily heated, is soft under the hammer, and throws out but few sparks when taken from the fire

Bar Shot—Consist of two solid hemispheres connected by a bar They are now no longer used in the service

Barb—The reflected points of the head of an arrow The armour for horses was formerly so called

Barometer — This well-known instrument was invented by Torricelli for measuring the weight of the atmosphere, or its pressure on the surface of the globe.

The following, extracted from Weale's Dictionary, will explain the principle on which the barometer is made —"It is well known that it is owing to the atmospheric pressure that water rises in a common pump after the air has been drawn from the barrel, but that the height to which it can be raised by this means is limited, and does not exceed 30 feet , a little more, therefore, than 30 feet balances the atmosphere Mercury being 12 times heavier than water, about 30 inches of mercury will also counterpoise the atmosphere "

"The principle of the barometer is simple If a tube, about 3 feet long, closed at one end, and open at the other, be filled with mercury, and with the open end stopped by a finger, this tube be reversed, and placed upright in a cup partly filled with the same liquid, the mercury in the tube in ordinary states of the weather will descend to 30 inches, measured from the surface of the fluid in the cup, and not much lower The mercury is sustained in the tube by the pressure of the atmosphere on the surface of the fluid in the cup Such a tube and cup so filled, would, in fact, be a barometer , and if a movable index were added to it, this simple instrument would indicate the changes which take place in the atmospheric pressure "

"When observations are made on land, above the level of the sea, a correction is required for altitude, since the weight of the atmosphere diminishes as we ascend It is owing to this that we are enabled to determine the height of mountains by barometers "

"The cause of the oscillations of the barometer in a gale of wind was first explained by the late Mr Redfield of New York A quantity of fluid in a cup, put in a rapid circular

motion, gives a representation of the form of that portion of the atmosphere which is within the limits of a storm A whirlwind which sets an extended portion of the atmosphere in a state of rapid revolution, diminishes the pressure over a corresponding portion of the earth's surface, and most of all at the centre of the whirl, where the depth of the compressing column of air will be least."

Barracks—The name is said to be derived from the Spanish "*barraca*" They are buildings erected by Government for the lodgment of troops Barracks in England, where the ground is sufficiently spacious, are made to enclose a large area, for the purpose of exercise and drill, but in India, except in a few stations, the barracks are detached houses, either built in line or in echelon The latter is considered the most desirable position, as it admits of the air circulating freely among all the buildings

Barrel, Gun—The cylinder of a gun, more generally applied to small arms, the manufacture of the barrels of which oftentimes forms a distinct trade to other parts of the gun, the barrel being made by different hands, and sometimes in different establishments Each barrel, after manufacture, has to be tested, and must receive the Tower mark of its having stood the necessary proof

Barrel, Piering—A term applied to the construction of bridges for military purposes with casks or barrels, when no pontoons or boats can be obtained

Barrels, Powder—The barrels in which gunpowder is packed They are of different sizes, *viz*, 100-lb, 50-lb, and 25-lb barrel Also the bouge barrel, which is of smaller dimensions than the 100-lb. barrel, and intended to be used, not for storage, but for holding loose powder or cartridges in a standing battery Barrels are composed of heads and staves, and are made by hand, in India, of teak wood, and bound round with four copper hoops. In England, powder barrels are made by machinery, and usually of American oak, bound round with four copper hoops and four ash hoops The 100-lb barrel is specially the barrel for packing powder in The smaller sized barrels are used for carrying about mealed powder in powder houses, and for the storage of saltpetre and sulphur The quarter size or 25-lb barrel is used for packing small arm ammunition in The bouge barrel is distinguished from the rest by having a leather bag attached to it, fixed on the outside of the barrel, under the second hoop The word "bouge" or "budge" is corrupted from the old word bouget, a leather bag All spare and empty barrels are returned to the Gunpowder Agencies, when no longer required in arsenals, to be repaired and set up afresh

The following are the dimensions of the 100-lb Indian powder barrel

Diameter of bulge	16	inches
" " head	14	"
Length of staves	20	"
Thickness of ditto at head	1	inch
" " bulge	$\frac{5}{8}$	"
Diameter of bung-hole	1 5	inches.
Weight . .	34	lbs.
Contents	100 to 112	lbs
" in cubic inches	3180	

The weight of a new barrel complete is from 35 to 40 lbs, and measures 4 08 cubic feet The price is about £ 0-16-6.

The dimensions of English barrels are as follow —

	Inches.	Wt when full.
lbs. 100 Barrel	15 × 17 × 21	lbs. 180
" 50 "	$12\frac{1}{2} \times 13\frac{1}{2} \times 17$	" 63

Barrels, Stove—For use in carrying powder in manufacturing departments.

Barricade—The term is derived from "*Barrique,*" in allusion to the defences of the streets of Paris during the disturbances of the League The barricade of a town is formed from any materials, stores, &c, available at the moment, such as palisading, made musket proof by sandbags, chevaux-de-frise, carts, wagons, iron railing, barrels, hampers, or sacks filled with earth to form a parapet, the object of the barricade being not only as a protection to people behind it, but to close up openings, streets, &c

Barriers — In fortification, are strong gates, so placed as to defend the entrance of a passage into a fortified place

Baryta (BaO)—A compound of oxygen and the metal barium possessing alkaline properties Chloride of barium is used as a re-agent to precipitate the sulphates in testing saltpetre —*Vide* Chloride of Barium

Base Line,—In military tactics, signifies the line on which all the magazines and means of supply of an army are established It also means the line on which troops in column move In surveying, it is the line on which a series of triangles are constructed for the purpose of determining the position of objects and places

Base of Operations,—In military art, means the original line on which an army forms, whether it be the frontier of a country, river, or any safe position from which an army takes the field to invade an enemy's country In case of retreat, the base of operations should be kept open to fall back upon If acting on the defensive, the position must be such as to prevent the enemy breaking the line and forcing the army away from its base

Base Ring—In smooth-bored ordnance, the ring which encircles the breech, connected with the body of the gun by a concave moulding, termed the base ring ogee

Basil—Tanned sheep-skin, used by saddlers and book-binders

Basiliske—A large-bored gun of great weight, used in the 16th century

Basket—The name given to the leather guard round the handle of fencing or single-sticks The leather of condemned pouches is often applied to this purpose

Basket Hilt—The hilt of a sword, so made as to contain and guard the whole hand

Bassoolah—A small hand adze, known as the "Indian adze," for preparing turnery woods

Bastion—In fortification, a work generally constructed at the salient angle of the polygon, consisting of two faces and two flanks The leading principle in the construction of a bastion is, that every part of it should be defended by the flanking fire of some other part of the works It is composed of a large mass of earth excavated from the ditch, and reveted towards the country with masonry Bastions are of two kinds, full and empty A full bastion is, when its interior surface is on a level with the rampart An empty bastion, when the interior ground is lower than the rampart

Bat-horses — Are baggage horses belonging to officers when on service

Bat-men — Were originally servants hired in war time to take care of the horses belonging to a train of Artillery, Battery, Baggage, &c. Men who are excused regimental duty for the specific purpose of attending to the

horses belonging to their officers are called bat-men

Batardeau—In fortification, a wall, 7 or 8 feet thick, which crosses the ditch at the salient angle of the bastion, there is a sluice in the middle and a turret upon the top, to prevent persons crossing, for field works it is composed of piles, planks, &c

Bath, Order of the—As explained in Brande's Dictionary, a British Order of knighthood On the day of his coronation, Henry IV conferred the dignity of knighthood on forty-six esquires, who had watched during the previous night, and bathed themselves in pursuance of a very ancient custom derived from the usages of the Franks The custom of making knights under the circumstances mentioned was discontinued after the coronation of Charles II, but George II re-instituted the Order It consists of three classes, G C B, K C B, and C B The Order is now extended to civil as well as military men

Baton—A truncheon or staff conferred upon Field Marshals as a symbol of authority

Batta—An Indian term, implying field allowances granted to troops in India in addition to their regimental pay

Battalion—A body of infantry of the maximum strength to be efficiently handled and commanded in action by one officer The strength of battalions varies in different armies In the British Service it rarely exceeds a thousand men, and is commanded by a Lieutenant-Colonel

Batten—In carpentry, a scantling of wood from two to four inches broad, and about one inch thick, commonly used to strengthen articles, such as boxes, &c

Batter—In the operations of a siege, to fire continuously at a revetment with the object of breaching

Batter—In fortification, the backward slope of a revetment or retaining wall

Batter-head—The flesh of a drum on which the drummer applies his stick

Battering-Ram—Of all the ancient offensive weapons, none were so efficacious as the "battering-ram" It consisted of a long pole or spar, headed with a huge mass of iron or brass, usually shaped like the head of an animal, from which its name was derived The spar was sometimes mounted on wheels, but more frequently suspended by cords from a triangle of stout beams In either case, the intention was to impel it violently forward against an opposing wall, not with the view of penetrating the mass, or even of dislodging a portion by its immediate shock, but to generate a vibration, which, continually repeated, would shake the strongest walls to their foundation, and eventually bring them down

Battery—Signifies, 1*st*, Generally, any number of guns grouped and in position for action 2*nd*, Specially, the unit of an artillery command, as a battalion is of infantry, or a squadron of cavalry 3*rd*, any work, permanent or temporary, considered merely as a position for a group of guns Movable batteries are divided into two classes, Siege and Field The number of guns composing a siege battery, or, as it is commonly called, a siege train, depends on the service it is likely to be engaged in, and all that has been laid down on the subject has been the minimum or unit strength of which a train should be formed, which can be multiplied or increased according to circumstances. The proportion,

however, that the several natures of ordnance should bear to each other in a siege train has been fixed, and will be found under the head of Siege Artillery This has reference to smooth-bored ordnance, the proportion having been laid down before rifled guns were introduced But since the introduction of rifled ordnance, the proportion of guns differs, and the constitution of the train has been altered

Batteries of Field Artillery are composed, at present, either of 12-Pr or 9-Pr rifled B L guns, of six guns each, which are to be replaced by the new bronze M L gun of 8 cwt for the Horse Artillery, and by a heavier gun for the Field Batteries,—at least this is under contemplation—the 8 cwt gun, or 9-Pr, being considered too light for any but Horse Artillery purposes Under the head of Field Artillery is included Mountain Batteries, composed chiefly of 7-Pr rifled guns

Under the third head, *viz*, Permanent or Temporary Batteries, there are four descriptions, *viz*, cavalier, elevated, sunken, and half-sunken batteries A cavalier battery has its platform for the gun carriage above the level of the ground, and is very rarely used An elevated battery has the platform on the level of the ground A sunken battery is excavated below the ground line, so that the gun can range just above it A half-sunken battery has both an interior and exterior excavation to furnish earth for the parapet

Battle—An action in which the forces of two contending armies are engaged for the accomplishment of some great object. The order of battle is the manner in which troops are drawn up before the attack is made, and varies with different nations It should, however, possess the inherent qualities of mobility and solidity To attain these two objects, troops which are to remain on the defensive should be partly deployed, partly in column, as the allied army was at Waterloo. But the corps destined to attack a decisive point, should be disposed in two lines of battalions formed into columns

Battles again, whether offensive or defensive, are reducible to three orders, each subject to some modifications —

1*st*—The simple parallel order, or that where the hostile forces face each other in parallel lines, to advance or receive the attack

2*nd*—Where no other combinations are practicable, there is the second order, or that with parallel lines reinforced upon one extremity To this class most of the great victories of ancient and modern times may be ascribed, for although it is not the most perfect in theory, it is the most constantly applicable in practice

3*rd*—The oblique order of battle is the third and the best class of tactical *dispositions*, but *in* the application, great simplicity of combination is necessary, and great prudence in the execution Against a manœuvring army well commanded, it will always be difficult to apply it, but when produced, the effect is instantaneous and decisive, it is the triumph of discipline and of grand manœuvre

Battle-axe—A military weapon, not now in use, but employed from the earliest times, by the Gauls especially In our own country, in former days, it was greatly used The Lochaber-axe is well known as having been a formidable weapon in the hands of the Scottish Highlander

Battlements are the indentures in the top of old castles and fortified walls, or other buildings, in the form of embrasures, for the greater

convenience of firing or looking through

Baume's Flux—Consists of 3 parts of nitre, 1 part of sulphur, and 1 part of sawdust, as given in Abel and Bloxam's Hand-book of Chemistry This flux is capable of inducing the fusion of different metals, partly on account of the heat evolved by its deflagiation, and partly because it converts a portion of the metal into a more fusible sulphide

Bayonet—A short sword or triangular-shaped dagger, fitted on to the muzzle of a firelock, in this position the bayonet gives the soldier increased means of offence and defence The name is said to be derived from the town of Bayonne in France, where it was first invented The original bayonet was nothing more than a blade of steel fastened to a helve of wood, which was thrust into the barrel, by this means the musket could neither be loaded nor fired conveniently, to remedy this, an elbow and socket were given to it, and hence the present mode of attaching the bayonet The blade is made of steel

Beak Iron—A conical pointed piece of metal projecting from the common smith's anvil, and on which the blacksmith bends his metal into any curved or ring-shaped form

Beak Iron, Brazier's — A conical point of metal attached to the anvil, similar to the smith's "beak iron"

Beak Iron, Cooper's—A T-shaped block of iron, having two perforations on its surface, for punching holes in the copper hoops of barrels

Beaker — A precipitating vessel made of glass, having a small beak or spout It is used in chemical operations

Beam—A horizontal piece of iron or timber, used to resist a force or weight, as a tie-beam, when it acts as a string or chain, by its tension, as a collar beam, when it acts by compression, as a bressummer, when it resists a transverse insisting weight

Beam—In steam engines, a large lever turning upon a centre, and forming the medium of communication between the piston rod and the crank shaft

Beam Carriage—In artillery, that part of the gun-carriage included between the breast and trail point In field carriages, the beam is formed of a solid block, if timber of sufficient scantling can be obtained, but if not procurable, it is formed of two pieces tabled one into the other Formerly, light field carriages consisted of two brackets fastened together by transoms, but this form, though it possessed strength, was found, it is stated, to be awkward and unhandy for quick manœuvring, the block trail, therefore, was substituted for all light field carriages, and has been also adopted for certain siege carriages

Since the introduction of the Indian field gun, the bracket pattern has been re-introduced into the service in the carriage adapted to this gun

Beam Scale — Is a simple lever, the arms of which are equal At the end of each arm a scale board is suspended by chains Scales of this nature are used for weighing stores of every description, and are supplied by arsenals to the different departments of the army The mode of eliminating the error in scales is, to place the body in one scale and counterpoise it by weights in the opposite scale, then remove the body and replace it by known weights, until the equilibrium is restored The sum of the latter weights will be that of the body required

Bearing—In carpentry, the clear

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distance between the supports of a beam

Bearing — In machinery, that part of a shaft or spindle which is in contact with the supports

Bearing—In surveying, the direction of an object with reference to any meridian line, or the angle formed at the point of observation between the meridian line (generally the magnetic) and the object

Bearers, Shot—For carrying hot shot from the furnace to the gun They are made of wrought-iron, and have three handles The name is also given to rings of iron, used for painting spherical projectiles, they are somewhat less than the diameter of the projectile, and have handles attached to them Under the name of "shot bearers" are implements used for lifting the heavier natures of rifled projectiles

Bed—In artillery, the frame or rest on which a mortar is placed and fired from Beds are to mortars what carriages are to guns They are made of iron for the larger sized mortars,—*viz*, the 13, 10, and 8-inch land service, and of wood for the smaller,—*viz*, the 5½ and 4⅖-inch The larger mortars are elevated by means of quoins, the smaller by an elevating screw The 13, 10, and 8-inch mortars in the Home Service are furnished with travelling carriages, and are thus described in the Manual of Field Service, 3rd Edition —

"These carriages consist of a bed of elm and oak, which is mounted upon wheels The 13-inch mortar carriage has an ordinary sized limber on 5-feet wheels, the same as is supplied with the new block trail carriage for the 32-Pr siege guns. It carries no ammunition The 10 and 8-inch mortar carriages have the limber carts (a modified trench cart), the same cart serves for both When the mortar is to be used, the wheels are removed, and the mortar and bed are placed on a platform" An ingenious contrivance was applied, some years ago, by the late Captain Machell, of the Bengal Artillery, to the common platform cart, whereby an 8-inch mortar could be placed on its travelling cart by four men It consisted of a capstan fitted to the head of the cart, and worked by handspikes

Beech-wood—Only one species (*Fagus sylvatica*) is common to Europe In England, the Buckingham shire and Sussex beech is esteemed the best The colour is whitish brown, of a uniform texture and closeness It is considered to be almost chemically free from foreign matters It is used in the manufacture of fuzes, and no wood has yet been found in India equal to it for that purpose It is valuable for wooden types in printing English powder barrels are sometimes made of this wood

Beegah — An Indian term A measure of land

One beegah=20 cottahs

One cottah, or 16 chuttacks=72[illegible] sq ft

Bees'-wax—*Vide* Wax

Bell-metal—*Vide* Alloys

Belligerent — Waging war Hence any two or more countries at war with each other are termed belligerents

Bellows—Are of four sizes—large, medium, small, and the double-hand bellows The larger kinds are used for the standing forges in arsenal workshops, and the hand bellows for light work Each field battery has a forge cart attached to it, and to this is fitted a small portable bellows about the size of an arsenal "small bellows The principle of the bellows is this that it attracts or draws in the air by

means of a valve, compresses it, and expels it with great force through the nozzle The large and medium bellows are formed of upper, middle, and lower boards, which are connected by strong leather, the small bellows have only two boards The valve is situated in the under-board of each, and there is also a valve in the intermediate boards of the large and medium size, the object of this being to give a continued instead of an intermitting blast, as in small bellows

Belting—Straps used in driving machinery They are made generally of buffalo hide, as it is stronger and more durable than any other hide There is a belting used for machinery in England which is made from the best flax yarn, invented by Messrs G Spill and Co, woven into one solid substance, and saturated with a compound to consolidate it Very good belting is made at the Government Tannery, Cawnpore, in the North-West Provinces of India.

Ben or Ven Teak—(*Lagertræmia microcarpa*) A tree which grows in the Annamallay forests in southern India It is not so strong or durable as teak It is used in arsenal workshops in the Bombay Presidency for packing cases, treasure boxes, and other common purposes

Bench, Vice—Is thus defined by Haltzepfiel —"An implement for fixing or firmly securing work that has to be subjected to the action of the file, and which is known as the 'smith's bench vice' or 'tail vice' The ordinary tail vices, or standing vices, are secured to wooden benches or tripod stands of cast-iron The table vice, which is commonly used in workshops, is secured to the table by a clamp and screw which are armed with teeth to give a secure hold, but it is usual to glue a small piece of wood on to the table to receive the teeth It is necessary that the joints of vices should be exactly parallel, both with the edge of the bench and with the ground, in order that the position of the work may be clearly known Common vices, from opening on a centre, or as a hinge, are objectionable; for though the jaws are almost parallel when closed, when opened widely, the radial position of the jaws causes the lower edges alone to grasp the work, and as in addition the front jaw moves in a circular arc, a wide object, on being fixed, is necessarily thrown out of the horizontal into an incline position The inconveniences, as above alluded to, have been removed by the vices opening on straight slides called parallel vices, because the surfaces of their jaws or chops, and also the bearings of their screws and nuts, always retain their parallelism consequently, whether the work be wide or narrow, it is always firmly grasped by the chops, provided the work be itself parallel"

Bendie—(*Thespesia populnea*) A wood known on the Bombay side of India, and used in the Gun-carriage Factory for spokes of wheels

Bengal Light—A blue light, composed of saltpetre, sulphuret of lead, and sulphur, remarkable for its clearness and brilliancy, and which can be seen for many miles

Berm — In fortification, a level narrow space a few feet wide, (depending on the nature of the soil) between the foot of the parapet and the scarp of the ditch, to prevent the mass of earth, of which the parapet is made, from sliding into the ditch In firm soils, the berm may be only from 18 inches to 2 feet wide, but in marshy soils may require to be as wide as 6 feet

Besiege—To attack or invest a place

Besieged—Those attacked when shut up within a fortress

Besieger—The attacking party

Beton—The French name for concrete which is used under water

Bevel Gear—In mechanics, denotes a species of wheel-work, where the axis or shaft of the leader, or driver, forms an angle with the axis or shaft of the follower to be driven In practice, it is requisite to have finite and sensible teeth in bevel gear These are made similarly to those of spur gear, except that in the latter they are parallel, while in bevel gear they diminish in length and thickness in approaching the apex of the cone, the teeth are of any breadth, according to the strength required

Bevel Wheel—A wheel having teeth formed so as to work at an angle either greater or less than half a right angle

Bevelled Handspike — A handspike the end of which is sloped off at an obtuse angle

Bheestie—An Indian term for a water-carrier Bheesties are attached to all regiments in India, whether in barracks or on the march The word "bheestie" is derived from the Persian *behisht*, heaven, or delight, with reference to the satisfying qualities of water to the thirsty man

Bibulous Paper—Blotting paper, or paper which has the property of drinking in or absorbing moisture Swedish bibulous paper is the best for chemical filters

Bickford's Patent Fuze—*Vide* Fuze

Bight—The double part of a rope when it is folded, in contradistinction to the ends.

Bildar—A name given to a certain class of natives in India, who are entertained as a part of the establishment of a camp or of a siege train on the march, for the purpose of clearing the camp or roads of filth and dirt, or cutting down brushwood in and around the camp

Bill-hook—An intrenching tool used for cutting down and clearing jungle, branches of trees, stuff for gabions, fascines, &c

Billeting—The temporary quartering of officers and soldiers in the houses of the inhabitants of any town or village The Articles of War detail the houses upon which this duty is imposed

Billets—Timber in logs, or in the rough

Bit, Boring — An instrument used in boring out the interior of ordnance In this bit the parallel shaft of the boring bar slides accurately in a groove, exactly parallel with the bore of the gun , the cutting blade is a small piece of steel affixed to the end of the half round block, which is either entirely of iron or partly of wood, and the cut is advanced by a rack and pinion movement, actuated either by the descent of a constant weight, or by a self-acting motion derived from the prime mover For making the spherical, parabolical, or other termination to the bore, cutters of corresponding forms are fixed to the bar

Bit, Bridoon—The snaffle and rein of a military bridle, which acts independently of the bit, at the pleasure of the rider It is the pattern bit used in the artillery This bit has been fitted with one ring, two links, and a spring hook on each side, instead of T s and links as hitherto

Bit, Curb—Two kinds are used in the service, one for the mounted non-commissioned officers and detachments of artillery, the other for the harness bridle

Bit, Spiral—A gun implement used for clearing the vents of ordnance when choked, after the gun drift has failed to do so

Bits, Bouching—Instruments used for boring a hole in the vent field of bronze guns, to receive the copper plug, or bouch, through which the vent is afterwards drilled

Bits, Centre, or Centre Bits—Steel tools of different shapes made to fit into a bent handle, something like the letter G, which, acting as a lever, allows of the tool being turned round and round by one hand, while with the other, the workman holds the top of the handle steady and vertically over the point of the tool Some of the bits or tools are for cutting out cylindrical holes, and are shaped at the cutting edge like a chisel, with a small point projecting from the centre of the edge, on which the instrument turns in the wood, and acts on the principle of a lathe On each side of this point, the chisel edge is bent sideways, in opposite directions, to allow of its ploughing up the wood before it with greater efficiency than it would do, if it were not so formed

Bitumen—A name for a number of inflammable mineral substances, known under the names of naphtha, mineral tar, asphalte, &c

Bituminous Coal — A coal which burns with a smoky flame,—such as Newcastle and similar kinds of coal In comparison with Anthracite coal, it possesses a smaller quantity of carbon, and its heating qualities are less

Bivouac — From *bis* "double," and the German *wache* "a guard" An army is said to bivouac, when it does not encamp at night, but rests in the open air uncovered

Black Lead—A name given, but erroneously so, to graphite. Black lead is found principally at Borradaile in Cumberland, and is used largely in the manufacture of pencils

Blackwood — (*Dalbergia latifolia*) This tree grows in Southern India in the Annamallay Forest, and in other parts of India and Burmah The wood is close-grained, strong, flexible, fibrous, durable, and of a deep purple colour It is used in the Bombay Gun Carriage Agency for beams, cheeks, axlebeds, poles of field carriages.

Blakeley Gun—Is built up of wrought-iron rings or hoops, shrunk around a cast-iron core It is constructed to load at the muzzle, thereby securing greater strength, and dispensing with all the questionable advantages claimed for breech-loading cannon This gun has been largely introduced into the Spanish service The shell used in the Spanish service in connection with this piece is of cast iron, with six buttons of zinc arranged in two rows around the cylindrical part of the ball, these enter the grooves in the bore, and give the rotatory motion to the projectile

Blank Cartridge—A Cartridge containing only powder, used for saluting and drill purposes

Blankets—Those used for horse blankets in India are, made in the country, and the best are manufactured in the Meerut district, on the Bengal side of India

Blasting—The rending of any mass of rock or masonry by means of some explosive force, such as gunpowder or gun-cotton. When gun-powder is used, a hole is bored into the rock or masonry, the diameter of which varies from one to six inches The hole is charged with powder and well tamped The shortest distance from the charge to the nearest surface of the rock or masonry work, is called "the line o

least resistance," and the charge is calculated with reference to it, and to the distance apart of the blasts When blasts are arranged at two-line intervals, that is, are twice as far apart as the length of the line of the "line of least resistance," the charge varies from about ¼ to ½ the cube of the "line of least resistance" But the nature of the material to be blasted has of course considerable influence on the size of the charges, and no absolute rules can be laid down on the subject The tools used in blasting are the jumper, which is a long iron crow-bar, with a swell in the middle, and the borer and hammer. There is also a tamping bar and needle required—these are of copper When the hole has been bored, and the charge lodged, the tamping needle is inserted in the hole, and the process of tamping commenced, this is effected by ramming home clay and the chips that have been taken out of the blast hole, by means of the tamping bar The latter has a groove in it, in which the needle fits, so as to remain undisturbed while the tamping is going on When this is finished, the needle is carefully extracted and the vent thus left primed with powder From this it will be seen that mining with gun-powder is a matter of much labor, whereas with gun-cotton, now much used for the purpose, not only is a much smaller charge in proportion required, but there is no necessity to bore so deeply

Blindage—A temporary bomb-proof or splinter-proof roofing, constructed of timber and the like, to give cover to magazines, batteries, hospitals, &c.

Blinds—Shutters of an embrasure; they are musket-proof, and at a siege, at the discretion of the officer commanding the artillery, are made up by the engineer department from materials available on the spot In the Crimea, coils of rope run round the chase of the gun were used, in addition to the ordinary blind, to protect the gunners from the fire of rifle-men, when laying the gun

Blistered Steel — Malleable iron, subjected to the process of cementation, whereby the iron absorbs carbon After being exposed for some days to the fire, the bars become covered with blisters, apparently from the expansion of the minute bubbles of air within the metal, hence its name In this state it is not much used, except for welding to iron By certain processes, it is made from this state either into shear or cast-steel

Block—When two or more pulleys are placed beside each other in the same sheaf and upon the same axis, this combination of pulleys is called a block Two blocks are commonly used at the same time the one attached to a fixed point, the other to the weight, and moving with it All pulleys are encompassed by one common rope, passing from one block to another, one of the ends of the rope being attached to one of the blocks, whilst the other is drawn by the power By means of this system or combination of pulleys which is called a tackle—

P W 1 number of parts of the cord passing over the movable block

Blockade—In a military sense, implies the surrounding of a place with different bodies of troops, who shut up the avenues on every side, and prevent all ingress or egress Paris, in the war of 1870, is an instance of this The design of the blockade is either to bombard the place, and so cause the besieged to surrender, or if bombardment is not resorted to, to oblige those who are shut

up in the town to consume all their provisions, and by that means to compel them to surrender for want of subsistence

Block-House—A small fortified barrack, frequently used as a keep or place of final defence in a field-work

Block, Tangent—A patch of metal in rear of the base ring of ordnance, into which the tangent scale fits or slides

Block-Tin—Tin which has undergone refining, either by liquation or poling, when it is run into iron blocks, each weighing about 3 cwt Tin thus treated is found to form in the melting basin three strata, of which the top stratum is most pure, the bottom most impure, and the middle of average purity The best qualities of this metal are the Banca, the Cornish, and the Spanish tin

Block-Trail—In artillery, that pattern of gun carriage, the trail of which is formed of one beam, or two beams tabled one into the other

Bloomfield Gun — An ordinary cast-iron gun, with a charge of one-third the weight of the shot It has from 1¾ to 4 cwt of metal to every 1 lb of shot The 32-Pr of 56 cwt., and 24-Pr of 50 cwt, are still in use

Blowing Charges—Used for different natures of common shells, and are a mixture of gun-powder and coal-dust The object of using the blowing charge is when it is not desirable or safe to burst the shell

Blue Lights—Used for signals They are to a great extent superseded by the service signal lights The composition of blue lights consists of saltpetre 4 parts, sublimed sulphur 2 parts, red orpiment 1 part.

Blueing—The art of imparting a blue colour to finished iron work or steel, such as gun locks, barrels, &c

Blues—One of the three mounted regiments of household troops This regiment was originally raised at Oxford, and was commonly called the Oxford Blues

Blunderbuss — A large bored fire-arm, capable of holding a number of musket balls or slugs The blunderbuss is a weapon of the past, and scarcely ever seen now

Board, Regimental—Consists of a certain number of officers assembled by order of the commanding officer of a regiment, for the purpose of investigating and reporting upon such matters as may legally be brought before it

Bob—The ball of a pendulum

Body—In a military sense, is a number of troops united under one commander

Body of the Place—In fortification, the space enclosed by the enceinte or line of bastions and curtains

Boiler—An iron or copper vessel for containing water to which heat is applied for the generation of steam Boilers vary in form and dimensions according to the purpose for which they are intended The best boiler is that which, with the least cubical content, gives the greatest heating surface

Boilers, Copper—The larger sizes of 1,000 and 500 gallons each, are used in boiling and evaporating saltpetre, and the smaller ones for a variety of purposes in saltpetre refineries, arsenals, and laboratories.

Boilers, Iron—Used in mixing hot laboratory compositions They are classed in arsenals as large, medium, and small, the former holding 20 gallons and upwards, the two latter, over 10 gallons each

Boiling Points of Liquids—Are as follow

Sulphuric Ether	100 deg
Alcohol	176 ,,
Water and essential Oils	212 ,,
Water saturated with salt	224 ,,
Nitric Acid	248 ,,
Phosphorus ignites at	100 ,,
Spirit of Turpentine	350 ,,
Sulpur volatalises at	180 ,,
Sulphuric Acid	640 ,,
Mercury	655 ,,
Tallow melts at	92 ,,
Wax, white, at	155 ,,
Wax, yellow, at	149 ,,

Bollards—Large posts driven in the ground to which hawsers or cables of any sort can be made fast They are recommended to be provided at the tops of ramps, or in narrow passages, and in masonry works

Bolster—A block of wood placed over the axletrees of gun carriages, into which the tongue of the perch enters Also the lower part of the cheek of a gun carriage The iron collar in which a gun turns in the boring bench The quoin or wooden bolster by which a mortar is raised in its bed

Bolt—*Vide* Canvas

Bolts, Screw — Are either of wood, copper, or iron, the latter chiefly used in the manufacture of gun carriages, such as the eye, axle, transom, and centre bolts, of varying diameter in the stem, each having a square head Bolts of this nature are made either of bar or bolt iron, by the process technically termed "drawing down," or "jumping", they may be made also by building up or welding Screw bolts are secured to the work they are intended for, by square or other shaped nuts

Bomb—A shell, or hollow cast-iron globe. General Cotty, in his Dictionary of Artillery Terms, states they were first used at the siege of Rhodes in 1522

Bomb-Proof—This term is given to the roofs of certain military buildings, which are formed so as to withstand the shock of heavy shot or shell falling on them Magazines for holding gunpowder are generally made bomb-proof.

Bombard—In the early days of fire-arms, and after the introduction of gunpowder, all guns were called "bombards" from which projectiles (stone) were propelled by gun-powder, afterwards the name was changed to cannon

Bombardier—The name given to the lowest rank of non-commissioned officers in the artillery Bombardiers rank as corporals of cavalry and infantry, *vide* Queen's Regulations Formerly, in the French Army, the duty of the bombardier was to serve mortars and howitzers only, and a battalion in the French service consisted of four companies of bombardiers and fourteen of gunners

Bombardment — Assault of a place by means of shells and other incendiary missiles The continental war of 1870 affords a recent instance of bombardment, in that of Strasbourg, and other fortified towns in France Great destruction to life and property must naturally be expected in the bombardment of a fortress, and which falls chiefly on the civilian portion of the inhabitants, though it is usual before bombarding a town to give women and children the opportunity of quitting the place History affords many instances, both in Europe and India, of the terrific effects of bombardment in the reduction of fortresses

Bone Spavin—A bony tumour in horses where the head of the splint bone joins the shank. Inflammation

of the ligaments of any of the small bones of the hock proceeding to bony tumour, classes as spavin

Boning Staff — A T-headed staff, used in conjunction with a plummet and line for taking short levels.

Bonnet—In fortification, a small work, with two faces, placed before the salient or flanked angle of the ravelin, between the two tenaillons.

Boom — An impediment drawn across the mouth of a river or harbour It is formed generally of timber logs chained together, and anchored or otherwise secured

Booming—The report of distant guns.

Booming out—In pontooning, the technical word of command to "shove out a pier"

Boot-and-saddle—A parade call in the cavalry and artillery, sounded half an hour before the turn out

Borax—A salt of great value as a flux, and used in arsenal workshops for soldering purposes in melting brass, and also in casting brass when the metal is in a state of fusion Native borax or *tincal* is found in India, Thibet, Persia, and other countries It is also manufactured in England from boracic acid with crystallized carbonate of soda

Bore—In artillery, the hollow cylinder of a piece of ordnance, measured from the muzzle to the breech Shell guns, howitzers, and mortars, have a chamber at the bottom of the bore to receive the charge, this is also included in the length of the bore In a piece of ordnance, the length of the bore should be such as to allow of the complete combustion of the whole charge If the bore be not of sufficient length for this purpose, a considerable portion of the charge will be blown out unconsumed. The length of the bore will, however, be limited by several practical considerations, such as the weight and length of the piece, the space it will have to occupy, and whether the gun is rifled or otherwise, &c In al muzzle-loading rifled guns the termination of the bore and of the grooves, respectively, are marked by two lines turned round the exterior of the gun

Bored-up Guns—*Vide* Ream.

Borers for Fuzes — Are of two kinds, termed 'hook' and 'hand' borers, the former consists of a hook, into which the fuze is placed, and a shank which contains a female screw The bit passes through the centre of the handle and male screw, and it is secured by a small screw which presses upon the bit The length of the bit is so regulated, that, when placed in the handle, it will enter sufficiently far into the composition when screwed down to the shoulder The hand borer is a simple instrument, and supplied to each gun

A new pattern hand gimlet borer has been sealed to govern manufacture for service with the 9-Pr bronze rifled M L guns of 8 cwt to be used instead of the hook borer

Boring Machine—Boring is a branch of turning, only in the former the tool is usually made to revolve while the work is at rest There are, however, exceptions to this In boring light cannon, which are cast solid, the gun is made to revolve, while the borer advances on a fixed axis, or in heavy ordnance, the gun may be fixed while the cutter revolves

Boss—A stud or ornament raised above the leather work of a cavalryman's horse trappings The term is also applied to the projecting ends of metal wheels or edge rollers.

Bothway's Blocks—Two natures of these blocks have been introduced into the service, the 18 and 15-

inch They are each single, double and treble blocks These blocks are to supersede, in future issues to the land service, the ordinary common blocks of 18-inch and upwards The existing store of iron gyn blocks is to be used up Bothway's blocks are made of the best English elm , in India of sissoo, which is a better wood , the swivel, hooks, and shackles, of the best manufactured scrap iron—the straps and pins for sheaves, also connecting pins of the best S C iron, and the sheaves of gun metal

Bottles, Soda Water—Are issued in India to European troops on the march, instead of wooden canteens, for holding drinking water The bottles are covered with leather, and have a strap attached, by which the soldier can sling the bottle over his shoulder

Bottoms, Shot—The block of wood attached to spherical shot or shell to steady them in their passage through the bore of the gun, and to keep the fuze in the axis of the bore when loading They were fastened at one time by tin straps , at another, with an adhesive composition These methods have been superseded by Colonel Boxer's mode,—*viz* , by attaching the bottom or sabot to the projectile, by means of a copper rivet driven through the centre of the wood into a small undercut cavity in the shot , the shape of the hole and the malleability of the metal causing the sabot to cleave most closely to the shot or shell

Bouche—Or vent piece in guns, is commonly made of pure copper, which has been well condensed by hammering, when cold It is inserted into the vent field, after the piece has been turned, in the form of a screw Bouches are fixed to all ordnance, and are of two kinds, the " through vent " and the " cone vent " Bouches can be removed or renewed if necessary

Bounty—A sum of money, formerly given by Government on men enlisting into the army. This donation is now withdrawn, probably in consequence of the improved condition of the soldier, as compared with what it was some years ago The pay now in the army is doubtless sufficient, with the increased comforts given to the soldier, to urge men to take to it as a profession without any other inducement

Colonel Burn, in his Naval and Military Dictionary, states that in the artillery bounty was formerly given for each day that a gun or mortar remained in battery during a siege.

Bow—One of the earliest arms or weapons we are acquainted with , of equal, if not greater, antiquity than the sling The first account we find of it is in Genesis, chapter XXI, verse 20, when the law-giver, speaking of Ishmael, says, " and God was with the lad , and he grew, and dwelt in the wilderness, and became an archer "

Bow, Cross—An ancient weapon of offence, in use in the 11th century Philip II, surnamed the Conqueror, introduced cross-bows into France In his reign Richard I of England was killed by a cross-bow at the siege of Chaluz

Bowline—In artillery, a very useful knot, known as the single, running, and double bowline knots The single bowline serves to throw over a post to haul on, also to sling a barrel , the running bowline for securing paulins on ammunition wagons , and the double bowline, for slinging a cask

Bowsing Rope—A rope used in the artillery service for moving a weight by simply hauling upon it

Box, Nave—The iron pipe or box which is introduced into the naves of all wheels, and in which the axle arm

works. The box was formerly made of gun metal

Box, Sextant—A surveying instrument, and which is equally portable with the prismatic compass, forming, when shut up, a box about three inches in diameter, and an inch and a half deep It measures the actual angle between any two objects to a single minute

Box, Store Siege—This box, in siege guns and howitzers, is carried between the cheeks of the carriage In it are packed small stores, such as hammers, wrenches, esses, washers, &c It can also be made available to convey ammunition from the magazine to the guns in battery One is allowed for each gun and howitzer

Box-wood (*Buxus emarginatus*)—A tree which grows in the south of Europe, also in the Himalaya mountains in the Kooloo district, and Kumaon. It is a valuable wood, of a yellowish color, close-grained, very hard, and heavy Amongst its other uses is that of plugs for the Enfield rifle bullet.

Boxes, Gun Ammunition—Are of infinite variety, every nature of gun and carriage, siege or field, having, it may be said, its own pattern box As the name implies, these boxes are for the storage and transport of ammunition, in time of peace or war

Boxes, Small Arm Ammunition—For holding all natures of ball cartridge These boxes are ordered for the future to be lined with tin

Brace, Carpenter's, with Bits—An instrument having a crank-formed shaft, used for giving motion to the various kinds of boring bits. It is made of wood or metal, and at the one extremity has a metal socket called the pad, with a taper square hole and a spring catch, used for retaining the drills in the brace when they are withdrawn from the work, and at the other, it has a swivelled head or shield, which is pressed forward horizontally by the chest of the workman, or, when used vertically, by the left hand, which is commonly placed against the forehead The carpenter's brace is sometimes fixed vertically with the power of revolving and of being depressed by a lever, in some respect like the smith's press drill

Brackets — In artillery, the cheeks or sides of ordnance carriages In field-gun carriages, the brackets consist of two strong blocks fitted very exactly to the block trail

Brad Awl or Nail-piercer—A short steel wire, sharpened at the point into a flat chisel edge, and put into a plain turned handle This edge being pushed into the wood, and the handle turned round, the tool divides the fibre and makes its way on the simple principle of a wedge, and does not cut away or remove any portion of the material

Bramah's Hydrostatic Press—*Vide* Hydraulic Press

Brass—An alloy of copper and zinc, a name commonly given to bronze ordnance, but erroneously so Brass in arsenals is confined to cast-brass, which is used for the repair of hinges, &c, and hammered brass, for soldering —*Vide* Alloys

Breach—An opening effected by artillery or mine, in the walls and defences of a fortified place A breach is practicable when a sufficient quantity of material has accumulated to render the ascent easy to the assailants

Breaching Batteries—Constructed on the crowning of the glacis to breach the revetments For the armament of breaching batteries, *vide*

Siege Artillery. Breaching batteries should fire about 20 rounds per hour on an average, with iron guns, and 12 for bronze The velocity with which shot should strike the work to be breached, should be less than what is given in usual practice, say from 1,000 to 1,200 feet per second, as low velocity causes greater vibration to the mass intended to be brought down The best method of forming a breach is, first to cut the masonry or revetment in a horizontal direction, and then vertically, at such distances, as the strength of the masonry, &c, may require, the height of the horizontal cutting being about ⅓rd the total height of the escarp from the bottom, the length generally from 20 to 30 yards Breaching batteries are placed at various distances, depending on the nature of the attack, and of the ground on which these works are to be placed They should be, as stated above, on the crest of the glacis, if practicable, but as this cannot always be the case, they may be at any distance up to 600 yards

Breaking Ground—In military operations, the first opening of the earth to form entrenchments, as at the commencement of a siege It applies also to the striking of tents, and quitting the ground on which troops have been encamped

Breaking-down—In the manufacture of gunpowder, is the process the mill-charges undergo on leaving the incorporating mills, and again after the press-cake leaves the press The machine to effect this operation, consists of two or more pairs of toothed gun-metal rollers, a hopper to contain the mill-cake, and an endless band to convey the cake to the hopper Breaking-down, after the powder leaves the incorporating mills, is necessary in order that the meal may sit well in the press-ing trays, previous to being subjected to hydraulic pressure The necessity, after it has been pressed, of breaking it down, is to admit of its passing easily through the granulating rollers

Breast-work — A hastily constructed parapet, thrown up as high as the breasts of the troops defending it *Vide* Intrenchment

Breech of a Gun—Is the mass of solid metal included between the end of the bore and cascable neck fillet

Breech Bushes, Armstrong Gun — Rings screwed firmly into the end of the powder chamber by means of the facing implements They have each an angular face, or seating, for the purpose of sealing the gun, in conjunction with a corresponding face on the vent-piece They are made of copper, with the exception of those in the 110-Pr gun, which are of wrought-iron

Breech-Loading Guns — As the name implies, are guns which are loaded by the insertion of the cartridge and shot at the breech instead of at the muzzle They were introduced into the service some years ago by Sir W Armstrong, and the light artillery of the British service are still armed with his breech-loading rifled guns The system of breech-loading in the manufacture of guns has been abandoned in the British service, as it has been found that the heavy B L. guns will not stand the large charges which it is necessary to give them, and in light ordnance no advantage is obtained in loading the gun at the breech In the case of the Armstrong field guns, the breech-loading apparatus is most liable to get out of order, and entails the expense of keeping up armourers for the efficient working of the piece, which is avoided in muzzle-loading guns.

Breech-loading is no new invention, many of the ancient cannon appear to have been loaded by removing a breech-part or chamber, inserting the charge at the breech, replacing the chamber, and securing it by wedging it behind Breech-loading has been applied to small-arms with much success, as the Snider and Martini-Henry rifles attest

Breeching—Harness adapted to the wheel horses of gun carriages, near and off, for the purpose of facilitating the stopping of a gun in motion Breechings, near and off, are strengthened with a "lay" of leather

Brevet—From the French *brevet*, commission, appointment It is also a rank in the army higher than that for which pay is received

Bridges—Military bridges are of several descriptions,—*viz*, bridges of boats, pontoon bridges, bridges of casks, trestle bridges, raft bridges The three first natures of bridges are most commonly used Trestle bridges are chiefly applicable to rivers in hilly countries, where the three first-named bridges cannot be used The raft bridge is the last expedient that should be adopted by an army in motion, as it has the lowest degree of buoyancy and general manageability Its merits are, that, at the expense of time, it can be constructed with less experienced workmen, it saves carriage, as it can be made of any materials on or near the spot In India, bridges of boats are generally formed from the boats of the country They are united to each other at a distance of about 6 feet by means of ropes, and anchored, they are then connected by planks, and thus afford a safe passage for troops A pontoon and cask bridge is similarly constructed *Vide* Pontoons

Brigade—A brigade of troops may consist solely of either of the three arms, or of the three arms combined, commanded by a Brigadier-General or Brigadier

Brigade Major — An officer appointed to aid the Brigadier in carrying out the duties of his brigade

Brigadier — A military officer whose rank is next above a Colonel He exercises the command of a brigade of troops In India, the rank of Brigadier-General is now given to officers commanding brigades

Broad Arrow—The ancient mark of Crown property It is applied generally to ordnance, as well as to other articles which belong to the War Department It was originally used only on Admiralty stores

Broadsword — A sword with a broad blade It is only used by some Highland regiments

Bronze—Bronze is an alloy of copper and tin in the proportion of 88 to 92 per cent of the former, and of 8 to 12 of the latter, but the amount of tin in bronze varies in different countries Bronze is used in casting guns, which are commonly, but erroneously, called "brass cannon"

Browning Barrels — The Queen's Regulations give the ingredients for the browning of small arms, and the mode of applying the ingredients, but the following receipt, known as the Pimlico Receipt, has been found to succeed in the Indian Arsenals better than the one alluded to in the Queen's Regulations The same materials, but in different proportions, will answer for the browning of Armstong guns

Pimlico Receipt

Acid, Nitric, by weight, lbs		0	1	14
Spirits of Nitre	,,	,,	0	4	8
,, ,, Wine	,,	,,	0	3	0
Tinct of Steel	,,	,,	0	5	4
Vitriol, Blue	,,	,,	0	0	12
Rain Water	,,	,,	1	2	0

*

The foregoing is sufficient for 100 Enfield rifle barrels The vitriol is first dissolved in the water, after which the other ingredients are added The liquid improves by keeping, but it should be kept in well-stoppered bottles As it is very strong, it should be applied with a sponge held in the split end of a stick, and so lightly applied as not to run down the barrel To re-brown Enfield rifled barrels, remove the lower sight leaf and spring and take out the nipple, proceed to remove the old browning with emery cloth, or an emery buff stick, that effected, plug up the nipple hole with a blind nipple, and the muzzle with a pin of deal-wood, 4 inches of which should enter it and about 8 inches project to hold by, now coat with wet lime, which, when dry, rub off with dry lime, then brush and wipe with a clean rag, the barrel being now clean, and perfectly free from grease, free the breech, so that, when its tail piece is rested in a cut made for the purpose in the scratch bench, the barrel will revolve at pleasure, while the breech remains stationary, and the browning on its tail piece be preserved

Process to be pursued in Browning

Coat the barrels with the liquid and let them stand about an hour, then coat them again, when they should be allowed to stand till dry, that is, till the rust flies off readily, then scratch card them Repeat this process six times, the barrels being placed during the 3rd, 5th, and 6th stages in boiling water for five minutes, and then allowed to cool, when the scratch card should be again applied. At the 6th stage the barrels should be finished off, taking out the breech, sponging out and oiling the barrel Then replace the breech, touching it with oil and wiping down the exterior of the barrel with an oil rag The nipple should now be replaced, and the sight leaf and spring lowered

Brunt—The troops who sustain the principal shock of the enemy in action, are said to bear the brunt of the battle

Buccaneers — Pirates who invaded the coasts of the West Indies and America during the seventeenth and eighteenth centuries They were composed chiefly of English and French adventurers, whose chief objects were war against the Spaniards and plunder of their ships and settlements After the peace of Ryswick in 1697, they gradually disappeared from the seas

Buff—The leather from which soldiers' accoutrements are made The following is the process pursued in its preparation —

Buff or "losh leather" is manufactured in India chiefly from the hide of the buffalo The process of softening, removing the hair, cleansing, &c, is precisely the same as that for common leather (*Vide* Leather), until the "pelt" is ready for tanning, when it has to be prepared for a process of oiling This is done by carefully removing or forcing off the upper grain of the hide, which renders both sides of it as nearly alike as possible The hides are then subjected to the process of "branning," that is, steeping in fermented bran from 4 to 12 hours, according to the atmosphere They are then wrung out or scraped over, and subjected to the pulling mill or stocks for 2 or 3 hours, afterwards they are spread out and oiled Cod oil is the best for this purpose The oiling is repeated during the first three or four days until each hide has absorbed ¾ of a gallon For the following three weeks, the hides are subjected to alternate soaking and drying, in which great care and attention

is required They are then exposed to a heating process, in hot-houses prepared expressly for the purpose, for two or three days, the heat not exceeding 130° Fahrenheit. Having arrived at this stage, the oil has now to be extracted, which is effected by a solution of potassa, in mills constructed for this purpose The buff is next carefully cleaned from all alkaline matter by frequent washings, and each hide hung up separately to dry The facing or surface is completed by rubbing both sides with pumice stone, and the buff is then in a fit state to be cut up into accoutrements

Buffalo—This animal is seldom used for military purposes. The natives of India, however, use the buffalo occasionally both as a beast of burden and for draft purposes

Buffers, Hydraulic—For checking the recoil of heavy guns The Hydraulic Buffer consists of a wrought-iron cylinder, closed at one end, the other end fitted with a cap and stuffing box, through which a piston rod passes The piston fits well into the cylinder, and is perforated with four small holes, the size of which varies with the size of the gun The cylinder is filled with Rangoon oil or with water, enough air space being left to act as an elastic buffer, which takes off the violence of the first impact of the piston on the oil The cylinder is firmly attached to the platform on which the carriage recoils, and the end of the piston-rod to the carriage itself, so that on the discharge of the gun, the carriage drives the piston through the oil or water with great velocity, gradually bringing the gun and carriage to rest in the required distance

Bulletin—Any official account which is given of public transactions

Bullets — Leaden balls, either spherical or elongated, and fired from small arms The service bullet used with the (Snider-Enfield) rifle is 55 in in diameter length, 1 055 to 1 075 in, weight, 466 to 468 grains with clay plug

It is an elongated bullet, and receives, at its base, a small wooden or clay plug, which, on the piece being fired, expands the lead and causes the bullet to fit the base tightly and fill the grooves

The Martini-Henry bullet is 45 in in diameter, and weighs 480 grains

Bullock—This animal is used in India for drawing heavy guns, ammunition, stores, &c All carts are drawn by bullocks in India, whether in the ordnance or commissariat departments The bullock for military purposes is obtained from certain districts in the country, and is much larger than the common species of this animal The pace of the bullock is slow, rarely exceeding 2 or 2½ miles an hour, but he has much endurance, and can draw 5 cwt the usual length of march, without being distressed

Buntin or Bunting—A thin woollen cloth, from which naval and military flags are made

Burette—A graduated glass instrument used in the chemical laboratory, and in the assay office, for the purpose of dividing a given portion of any liquid into 100 or 1,000 equal parts

In the use of the burette much loss of time and risk of error are avoided, and in the analysis of large quantities of saltpetre, such as is carried on in gunpowder factories, it is invaluable

Burns — As scalds and burns are not unfrequent in the laboratory, the following will be found a useful liniment —

Sweet Oil	8 parts,
Hartshorn	1 part,

or equal parts of linseed oil and lime water

Burr—Any roughness or unevenness observed in the barrels of guns after manufacture, or on balls which have been cast, or on the edge of tools when ground, or in wood-work when turned, caused by the inequality in the fibres of the material

Bursting Charges — Are charges of powder placed in shells of all natures, in order that they may burst at the distance required The charge is ignited by means of a fuze There is a variety of patterns of bursters in the service, made of paper and serge For the most part shells are filled by capacity, not measure, but there are certain exceptions *Vide* Majendie's Treatise on Ammunition

Busby—The head-dress worn by the Artillery and Hussars in the British Army It consists of a fur hat, with a bag hanging from the top over the right shoulder The bag, which is made of the same color as the facings of the regiment, appears to be of Hungarian origin, and intended to ward off a sword cut

Bushing or Bouching—The operation of fitting one piece of metal into another, which is generally bored for that purpose, in order to receive either a fresh aperture, such as the vent of a gun, or as in the case of a shell, to receive a fuze which does not fit the original fuze hole

Bushing Tents—This is resorted to when the soil will not hold well, or in stormy, blowing weather It is only necessary under these circumstances to bush the main outer ropes of the tent, which is effected by burying, a sufficient depth in the ground, a strong bush at each angle of the tent, to which ropes are attached

Button — In artillery, the rear extremity of a gun, known as the cascable button It is an ellipse flattened in the direction of the axis of the piece It is generally about one calibre in diameter

Buttresses or Counterforts—Are solid constructions of masonry, raised at short and equal intervals on the interior side of the revetment of the ditch, to strengthen and support it

Butts—Mounds of earth raised on military practice grounds behind targets, for the purpose of stopping the onward course of shot, bullets, &c

C.

Cable—*Vide* Rope

Cadastral—This term is derived from the French word *cadrer*, to square, and signifies a survey on a large scale, such as has been adopted of late years on the Continent of Europe, and is now used in England in the Ordnance maps The measurement corresponds so nearly to 25 inches to the mile, that it is usually spoken of as the 25-inch scale It has the further advantage of bearing, within a very small fraction, the proportion of one inch to an acre According to an article in the *Edinburgh Review*, for October 1863, from which the above information is taken, a cadastral, as opposed to a topographical map, may be defined to be one on which the objects represented agree, as to their relative positions and dimensions, with the objects on the face of the country, while a topographical map, drawn on a small scale, exaggerates, for the sake of distinctness, the dimensions of houses, and the breadth of roads and streams, and is, owing to its smaller size, necessarily less correct than a cadastral plan

Cadet—In military phraseology, a term given to students who are being educated at a military college

for the army Cadets on passing their final examination receive commissions, if educated at Woolwich, into the Artillery or Engineers, if at Sandhurst, into the Infantry Cadets have been known to do duty, as such, with regiments, whilst awaiting their commissions In the French language, the word *cadet* means a younger member of a family

Cadre—Literally a frame The skeleton or staff of a regiment, list of officers

Caffin's Machine—Is a machine for filling cannon cartridges As described by Captain Majendie, it consists of a gun-metal wheeled "carriage," which receives two brass measures, and travels up and down on gun-metal rails underneath a large wooden hopper

The hopper is for the reception of the powder from which the cartridges are to be filled, the measures are for measuring the charge into the cartridges There is a hole in the bottom of the hopper, through which the powder flows into the measures as they are respectively brought under it, and there are two holes, fitted with brass spouts, through which the measures, in their turn, discharge their contents into the cartridges

The machine is so arranged that while one measure is filling the other is emptying, and by working the carriage backwards and forwards—which is done by means of ropes attached to a wooden treadle and worked by the feet—cartridges can be filled with great rapidity (*Vide* Supplement)

Caisson—In artillery, a tumbril or ammunition wagon

Cake, Mill—Gunpowder after it leaves the incorporating mill, its thickness in this form varies from ¼ to ½ an inch It is of a blackish gray colour, and, when broken, should exhibit the same uniform appearance without presenting any sparkling or yellow specks, should it do so, it is a sign that the ingredients have not been properly mixed or incorporated After the mill-cake leaves the incorporating mills, samples of it are tested "for strength" in a small eprouvette

Cake, Press—Gunpowder after it has been subjected to hydraulic pressure The R L G, L G, and F G powders of the service receive a pressure of 70 tons, and the R F G of 50 tons, to the square foot

Caked Gunpowder—Gunpowder which has become lumpy from having imbibed moisture In this state little permanent good can be done to it by reeling and re-drying it, as it subsequently absorbs more moisture than it did before It is ordered, therefore, that powder in this state shall not be re-stoved

Calibre—The diameter of the bore of a gun is its calibre Guns are denominated according to the weight of their shot, siege howitzers, mortars, and shell guns in terms of their calibres, expressed in inches and decimals, thus a 24-Pr gun, from its shot weighing 24 pounds, is termed a 24-Pr, and an 8-inch howitzer, or 8-inch mortar, from the diameter of its bore being of that size, is denominated an 8-inch howitzer or mortar The latter appears to be the more exact method of classing ordnance, for the weight of shot, from the difficulty of casting them perfectly spherical, and the non-homogeneity of the metal, can never be depended upon, whereas, in thus giving the size of the piece by measurement, the true diameter is expressed The calibres of all rifled guns, from the 12-in to the 7-in, the projectiles of which are oblong, are expressed in

inches and pounds, but the smaller natures of rifled ordnance in pounds

Call—In a military sense, applied to the assembling of troops Thus —A call to arms , roll call , tattoo call Also the sounds given by a bugle or a trumpet are termed " calls "

Callipers—Are gun implements of different natures They are used for measuring the bores of ordnance, diameter of shot and shell, and in ascertaining the thickness of the metal of spherical projectiles, &c

Caloric—An imaginary substance supposed to be diffused through all kinds of matter, and the sensible effect of which is *heat*

Cam—A contrivance in machinery for converting a rotatory into a reciprocating motion On the breech cylinder of the Armstrong gun a ring is fitted, to which cams are attached This ring fits with its interior octagonal figure with the exterior octagonal figure of the cylinder The weighted lever, with a piece projecting, works on the cylinder also , and on the lever being worked round, the piece projecting catches the cams, and this screws home the breech screw

Camel—As a beast of burden the camel is used in certain parts of India to carry the baggage of troops The utility of camels for this service is confined to those parts of India where the climate is very dry In a damp, marshy country, they are useless A camel can carry four maunds, or 320 pounds, the usual length of a march, without being distressed

Camera Lucida—An instrument which enables any one without the previous knowledge of drawing or perspective, to delineate any object or landscape on paper, by simply tracing with a pencil the outline depicted on the paper

The instrument consists of a quadrangular prism of glass, which is mounted in a brass frame supported by a brass tube, capable of being lengthened or shortened at pleasure, and which, accordingly, affects the size of the picture Fixed on the surface of the prism is a thin block metal plate, having a small hole in it for the observer to look through In taking a sketch, the observer will see the picture delineated on the paper, and at the same time he will see the point of his pencil, which he must carry along the line of the object to be traced The principle of the Camera Lucida is to refract the rays of light coming from the object to be drawn to the eye of the observer, which, at the same time, is directed, as shown above, on to the paper through an orifice in the setting of the prism

Camera Obscura — A darkened chamber having an arrangement of lenses and mirrors for concentrating the rays of light from the surrounding objects, producing an image of them on a table prepared for the purpose inside The photographic camera is an adaptation of the above

Camouflet — A small mine of about 10 lbs of powder, sufficient to compress the earth all around it, without disturbing the surface of the ground It is sometimes formed in the wall or side of an enemy's gallery, in order to blow in the earth, and to cut off the retreat of the miner

Camp — The whole extent of ground occupied by an army under canvas Its breadth should not exceed the length of line occupied by the troops, when drawn out in order of battle With respect to the situation of camps, it is a general rule that both wood and water be near at hand Camps are either permanent or movable , in the former case the troops live

in huts made of wood, as in the camps at Aldershot and Shorncliffe and in the latter case under canvas, as at Colchester Artillery, in selecting a position for a camp, should get as near water as possible, with reference to the supply required for the cattle attached to batteries They should avoid pitching their camp too near a village in case of fire, and pitch always to the windward of it, if possible High and dry ground should also be selected, and it is an axiom in selecting ground for an artillery camp, that there should be a clear space to its front In standing or movable camps, great attention should be paid to sanitary arrangements

It appears in the Prussian military system that Prussian encampments are always square in form, no matter what the number of troops on the ground The camps are guarded by sentinels scattered on the fronts and wings from 30 to 40 paces from each other

Campaign — A period during which an army keeps the field and carries on a series of operations

Camphor—(*Laurus Camphora*) An exudation from the Indian laurel tree, having a fragrant smell It is chiefly found in China and Japan, and is in appearance white and transparent, of a light and highly inflammable nature, and, in consequence of its combustible powers, is used in fire-works It is soluble in spirits of wine As a preservative to cloths of every kind against insects, it is a valuable substance

Canister or Case Shot—Ammunition which is used for all natures of ordnance It consists of a number of cast-iron balls placed in a tin or sheet iron cylinder The balls vary in weight and diameter, according to the nature of the ordnance for which they are intended Canister is used in lieu of grape shot, which was in general use some years ago, but is now nearly obsolete except in the navy It is a question, in these days of long-range rifles, whether case shot, which may be said to be only effective at 500 yards from rifled guns, will be so valuable as it has hitherto been Its value, with rifled guns, would appear to be in case of any sudden rush upon the gun

Cannon—The term cannon is derived from *canna* (a reed) The first cannon were called *bombarda*, from the great noise which the firing of them occasioned They were nothing more than bars of iron, arranged in such a manner that their internal aspects should form a tube the bars were not welded, but merely confined by hoops On some occasions, expedients much less efficient than this have been had recourse to, cannon having been made of coils of rope arranged in a tubular form, and even of leather or wood

Canteen — A regimental establishment for the supply of liquor to the soldier It is managed by a committee of officers *Vide* Queen's Regulations

Cantonments—When troops are detached and quartered in different adjacent towns and villages, they are said to be placed in cantonments In India, the permanent military stations are so termed

Canvas— A material made from hemp, and much used for artillery purposes, such as the covering of the seats of gun-carriages, caps for sponge heads, soldier's bags, aprons for the vents of guns, paulins for covering stores, &c The canvas in use in arsenals in India is of two kinds,—English, and that manufactured in the country The former is used for

aprons, gun sponge caps, and paulins, &c , the latter, for artillery practice curtains Canvas is received in bolts, measuring, average length, 37 yards, width, 2 feet A bolt of country canvas measures in length 38 yards, and is 2 feet wide The chief places of manufacture of country canvas are in Bengal, and at Cuddalore and Travancore in the Madras Presidency

Caoutchouc—Called elastic resin or India rubber, is produced from the syringe tree of Cayenne and other parts of South America It has also been discovered in considerable quantities in Java, Penang, Singapore, and Assam Caoutchouc oozes out as a vegetable milk from incisions made in the tree, and hardens gradually on exposure to the air, assuming, when it becomes solid, an extraordinary degree of flexibility and elasticity The sp gr of caoutchouc is about 0 925 It melts at 243° According to Faraday, the ultimate composition of caoutchouc is—carbon 87 2, hydrogen 12 8 It is insoluble in water or alcohol, but soluble in washed ether

Cap Square —In artillery, that part of the iron work of a gun carriage which folds or laps over the exterior portion of the trunnions of a piece of ordnance, when it is laid in its bed or carriage The front of the cap square is fastened by a chain and key to the eye bolt , the rear, by means of a catch hinge in the garnish plate

Capillary Attraction—If the extremities of tubes of very fine bore be immersed in water, the water will ascend in them to a certain height, which is great in proportion to the narrowness of the bore of the tube Such tubes are called capillary, from their bore being not much thicker than a hair, and this form of adhesion is, therefore, called *capillary attraction*

Capital — In fortification, is a line drawn from the angle of the polygon to the point of the bastion, or from this point to the middle of the gorge It bisects the salient angle of a work

Capitulation—The surrender of a garrison or an army, on stipulated conditions

Caponniere—In a fortification, is the passage from the body of a place to an outwork It is of two kinds, single and double, and is either covered or uncovered , in the former case, generally bomb-proof, and the sides loopholed

Caps, Percussion — Small cylinders of copper, closed at one end, in which a small charge of fulminating powder is placed They are used to ignite the charge in certain small arms The military percussion cap slightly differs from the ordinary sporting cap, in having flanges round the open portion or brim of it, to enable the soldier to take a good hold of the cap Percussion caps are made by machinery driven by steam The process of manufacture is as follows —Sheets of 16 oz copper, or copper weighing 16 ounces to the square foot, are cut up into strips, three inches broad, and passed into the machine for receiving them, which, from that moment, converts them, by a very speedy and ingenious process, into caps ready to receive the fulminating charge , they have, however, previously to be washed in diluted sulphuric acid, to free them of all red oxide which may remain on the surface of the copper The caps are then washed in clean water, and boiled in a solution of pearl ash to remove the oil The machine that forms the caps turns out at every beat of its progress three or four caps at a time, and the speed with which they can be made

depends upon the regulation of the steam power After the caps have been steeped in diluted sulphuric acid for some time, they are dried, and placed on gun metal plates, holding a regulated number, ready to receive their charge, which is accomplished in the loading room, they are then removed from thence to the compressing machine, after which they are taken to the varnishing machine to fix the charge in the cap This machine is so adapted, that each cap receives one drop of varnish composed of spirits of wine and shell lac The plates are then removed and placed on steam baths, for the purpose of drying and fixing the varnish in the charge Glazing is the next process, which is effected by the slight pressure of a spindle upon the charge This process, it is believed, is dispensed with in the Home Service The caps are then closely examined to see that each has received its charge, and afterwards weighed, and packed away in tin boxes

The new Martini-Henry rifle is not fired with a percussion cap, but has a small quantity of detonating composition in the end of each bullet, which is exploded by a direct-acting piston

Capstan—A strong massive piece of timber, the upper part of which is pierced with holes for the reception of bars or levers to which the power required is applied Round the capstan a rope is coiled, to the end of which the weight to be lifted is attached

Captain—In the army, an officer who commands a troop of horse, a company of infantry or artillery The title of captain was first used to denote the chief or head of a company of troops or body of men

Carabiniers—All regiments of light armed horse were formerly thus called, but since the establishment of Hussars they have lost that appellation.

Carbine—A small arm of shorter dimensions and less weight than a musket, and used by both cavalry and artillery Carbines are of two kinds, smooth-bored and rifled, many of the latter loading at the breech The converted Enfield rifled carbine, now the Snider, is the arm used by artillerymen The cavalry use Terry's, Westley Richards', and Thorpe's carbines; all loading at the breech, but it is believed that they are to be, or have been, withdrawn, and the Snider-Enfield used in lieu

Carbon—Is found in many minerals, and in most vegetable and animal substances Carbon, or pure charcoal, is found in its pure state in the diamond As charcoal, it burns quickly and strongly, and preserves its heat for a long time Carbon abounds in coal, but mixed up with iron, sulphur, and other bituminous constituents. It is also one of the elements that forms carbonic acid with oxygen

Carcasses — Shells of greater thickness of metal than common shells of the same diameter, and having three vents instead of a fuze hole These holes admit of the burning composition, with which the shells are filled, acting with great force and vigour on whatever the shells may fall Carcasses are chiefly employed in bombarding towns, harbours, &c, and may be fired from mortars, howitzers, or guns, but, generally speaking, are fired from the former They burn for the space of eight or ten minutes, and the nature of the composition is such that it will burn under water Carcasses are fired with service charges, except the 13 and 10-in, which are fired with 16 and 9 lbs respectively

Carriages, Artillery—Em

brace all carriages for the transport and service of guns, their ammunition, and stores Those on which land guns are mounted are of three natures, Field, Garrison, and Siege carriages, and since the introduction of heavy rifled guns, wrought-iron carriages of two constructions, "single-plated," and "double-plated," are in use, with which are issued iron platforms with slides The carriages for the conveyance of ammunition, termed wagons, are for the most part alike, the interior fittings of the boxes only differing according to the nature and calibre of the pieces the carriages accompany Wagons will be described under that head The carriages used in India are all made up in the country, where, at each Presidency, there is a Gun Carriage Manufactory The woods used for this purpose vary in the different Presidencies, as the same wood is not always to be obtained in each

Carriages, Field — Artillery carriages on which the lighter natures of ordnance, with their ammunition, are mounted, the former being termed gun carriages, the latter, ammunition wagons In the Home Service, and partly in the Indian, the field batteries are composed of 12 and 9 Pr B L rifled guns (Armstrong) mounted on wooden carriages The new field gun, about to be introduced into India, has an iron carriage The field carriage for the Armstrong gun consists of the ordinary field service gun carriage, with a few alterations The block trail, wheels, trail eye, &c, are the same, but the carriage is fitted with a traversing arrangement, to correct the line given by the movement of the trail as heretofore The trunnions of the gun fit into trunnion holes which form part of a sliding frame To this frame a lever is attached, which is pivotted to the carriage, and by means of a nut and screw the gun on the sliding frame is made to traverse, to correct the rough laying by movement of the trail, right or left The elevating screw works on a ball and socket, in order that the traversing screw may give lateral range, and not, as with the old elevating screw, on trunnions only, when all lateral range was given by the trail

Carriages, Garrison — Are used for such guns and howitzers as are not intended for transport, and which are generally placed on the ramparts of a fortress They are usually made of iron Since the introduction of heavy rifled guns, the patterns of garrison carriages have been modified to suit the nature and weight of the ordnance

Carriage, Moncrieff—A barbette-traversing carriage, invented by Captain Moncrieff, of the Edinburgh Artillery Militia, having for its object the power of mounting guns with counter-weights, of using them in gun-pits, and of laying them with reflecting sights

In a lecture given in June 1866, at the United Service Institution, by Captain Moncrieff, he explained that since the introduction of rifled guns and small arms, the protection afforded to the artillery and the detachment serving the guns in battery, was not proportionate to the increased power of these arms of precision, and that the necessary protection such as casemates and turrets afforded, could not be made available except at great expense, and even then at the sacrifice of range of fire It was apparent to him, therefore, that if extended range were required, guns must still be mounted *en barbette*, thereby necessitating the exposure, whilst loading, of the gun detachment

The principle of Captain Moncrieff's invention is this —

By a simple application of counter-weight with a moving fulcrum, the carriage lowers the gun out of fire The gun of its own accord rises into the firing position, the energy of the *recoil being stored* up to make it do so

The advantages, as set forth by the inventor, are as follow —

It enables a small gun detachment, behind a mound of earth, to load and point the gun in this protected position without being seen

To fire the gun without the men being exposed

It effects an enormous economy of labor, material, and life

From the fulcrum between the gun and counter-weight being a movable one, the jar and shock caused by firing, and transferred by friction to the platform, is avoided

It is only exposed to direct fire during the short time required to discharge the gun, which, on firing, descends of its own accord out of harm's way

For naval purposes, Captain Moncrieff has also invented a means of raising and lowering guns from the lower to the upper deck, and *vice versâ*, by the introduction of the Hydro-Pneumatic carriage, but, as he explained in a recent lecture, this new contrivance is as different from the system now adopted for land service as could be imagined, there is in it neither a moving fulcrum nor a counterweight, which are the grand characteristics of the land service carriage Instead of using the force of gravity, pneumatic agency is employed as the balancing force, and the recoil is absorbed by the same agency

Carriages, Mountain—The pattern carriage hitherto used, and still in use, for mountain guns in India, is block-trail, but most unsuited for the service it has to perform, as it does not admit of the gun being either elevated or depressed to any extent, which capacity is much needed in carriages of this nature

The 7-Pr M gun, of which there are a few in India, is mounted on a steel carriage .

Carriages, Siege—Are carriages on which siege guns are mounted and are termed cheek trail or bracket carriages They are composed of two nearly parallel sides or cheeks connected together by three stout pieces of timber termed "transoms," an axletree bed, and axletree The transoms are so placed as to connect the brackets together at the head, centre, and trail of the carriage, the trail transom having a hole through it to receive the pin-tail bolt of the limber The brackets have two sets of trunnion beds cut out in them, one termed *the fighting* bed, the other the travelling bed, in the latter, the gun is always placed on the march, as it distributes the weight more evenly over the carriage A siege carriage, similarly to a field carriage, is attached to a limber for the purpose of transport, but the siege limber differs from the field limber, as it carries no ammunition boxes

Carrier—The name of a species of pigeons, termed carrier pigeons, which are used in war time to convey messages to any particular city, post, or detached wing of an army During the campaign of 1870 between France and Prussia, carrier pigeons were constantly used

Carronade—A piece of ordnance now almost obsolete The carronade took its name from the Carron Foundry in Scotland, being the first kind of ordnance cast there, and was introduced

into the service in 1779. Carronades are short pieces of ordnance, and have less metal than guns of the same calibre, being intended not so much for long ranges, as to project shot of large calibre with accuracy to such distances as vessels of war in those days were supposed to engage at, viz, from 400 to 600 yards These pieces have no trunnions, but are cast with a loop underneath, a bolt passing through attaching them to their carriages. They have no swell at the muzzle, but an enlargement of the bore or cap to facilitate the putting in of the shot, and to save the rigging and hammock nettings on board ship They have a sight on the reinforce ring, and their chambers are cylindrical, the charge is one-twelfth the shot's weight

Carry—To carry, in a military sense, is to obtain possession by force, hence "to carry by assault"

Cart — A frame-work of wood, with sides, front and end boards, placed upon two wheels, and drawn by one or two horses In the artillery service carts are very generally used, and those attached to light field batteries for the carriage of stores are termed store carts In India these carts have bullock draft A new pattern cart has lately been introduced into the service for the carriage of small arm ammunition in the field

Cart, Hand—Is used for carrying ammunition and stores, especially in the supply of advanced batteries, when wagons cannot conveniently approach

Cart, Sling—This cart is used for moving heavy guns, not exceeding 65 cwt., on hard level roads The cart weighs 18 cwt.

Cart, Trench—Only differs from the hand cart in being stronger but smaller It can be used for carrying 10-inch or smaller mortars and their beds.

Cartouch, Gun — A painted canvas case for holding the cartridges of a field battery There is one to each ammunition box The pattern cartouch for the batteries in India is made of coarse Europe canvas, cut to the size of the compartment of the ammunition box for which it is intended, and sewed with twine soaked in tar It is then painted Copper cartouches were formerly in use with the Indian batteries, and for damp climates, such as Assam and Burmah, they will be found to be more serviceable than canvas

Cartridge, Drill—For B L ordnance is made of leather The interior consists of a wooden cylinder, packed round with felt and a wooden dummy lubricator of such length and diameter as, when covered with leather, to form a cartridge of the same dimensions as the service cartridge A copper plate is fixed at the base to prevent injury from the explosion of the tube

Cartridge, Gun—A bag in which the charge of powder is placed The size and form of cartridges depend on the nature of guns with which they are to be used, and the purpose for which they are required They are made of serge, silk (a material made entirely from refuse silk), and raw hide,—serge for service, silk for saluting or exercising, and raw hide for drill purposes Serge or flannel cartridges are hooped (stitched round with rings of thread or braid), which tends to keep them in their proper shape when filled

In examining cannon cartridges, (filled or empty) the flannel should be perfectly sound throughout, and the sewing uninjured, and free from all appearance of moth If filled, the powder

should be free from all lumps or dust Dust in powder in any package or parcel of cartridges will be shown by the flannel appearing black and dusty on the outside

To restore the cartridge, if the powder has become caked by pressure, gentle rolling will bring it to its proper state, but if it has been caked from wet, it cannot be restored without injury to the grain

Cartridges which are injured by moths, or have the flannel torn or damaged, or of which the powder has been wetted and caked, or which is very dusty, are unserviceable

Cartridge, Small-arm — Consists of a paper case in which is contained the exact charge of the musket or rifle, including the powder and bullet, and if a breech-loader, the detonating charge

The cartridge in use at present is that known as the Snider-Enfield or Boxer cartridge, but the Martini-Henry rifle having now been introduced, the cartridge for that piece will chiefly form the small-arm ammunition of the service In India, where the native troops are for the most part armed with smooth-bore muskets, the cartridge adapted for that arm is the ammunition used, but it is probable that they will all receive the Enfield rifle or converted Enfield Some regiments have already been armed with the Enfield rifle *Vide* Small-arm Ammunition

Cascable — In artillery, that portion of a piece of ordnance in rear of the base ring, it is composed generally of the button, the neck, neck fillet, and the base of the breech

Case-hardening — An operation of great importance in the treatment of iron, whereby a thin casing of steel is given to it, and the conversion can be carried to an extent which leaves the central parts of the metal in their original condition of soft fibrous iron, or of cast-iron

Case Shot — Another name for canister This nature of ammunition is fired from all ordnance

Casemate — A chamber made within the ramparts of a fortification, to contain a number of guns, embrasures being cut for them through the revetment, in some systems, their particular use is to defend the ditch Casemated batteries are sometimes used in the sea faces of works, and in defending the entrance of harbours, in which case they consist of a bomb-proof arch, open to the rear Iron plating of various thickness is also used in the protection of the embrasures of casemates

Cashiering—The dismissal of an officer by a Court Martial for dishonorable conduct, whereby he is rendered incapable of serving Her Majesty for the future in any military capacity

Cask — In military operations, casks are used to form bridges across rivers They should be about 4 ft 3 in long and diameter at head and bulge 2 ft 2 in and 2 ft 9 in respectively, but any barrels available will answer

Cast-iron—Is the oxide of iron, which, in the process of fusion, gives off a certain amount of oxygen, and combines with the carbon, the result being cast iron, which is fusible but brittle It is obtained from the ore by smelting, freed of many of its impurities, and run into moulds, from which it receives the name of pig-iron Cast-iron has been largely used until very lately in the manufacture of iron ordnance It is observed to be of three kinds,—white, gray, and black White cast-iron is useless for the manufacture of guns, from its very brittle quality Its white appearance is owing to the small quantity of carbon in proportion

to the metal Gray cast-iron is a less brittle metal, containing more carbon than the white metal This is the kind made use of in casting guns Black cast-iron contains a large quantity of carbon, which gives it the color named, and renders it, by its excess of this quality, very fusible, but not tenacious or cohesive, and hence not fit for ordnance purposes It is believed that, at no distant period, cast-iron guns will become obsolete in the service They are by degrees being replaced by wrought-iron rifled guns

Cast-steel—Blistered steel, fused and cast into ingots, when it becomes more uniform in texture and of superior quality, from the more equal distribution of carbon throughout the mass The best kinds of cutlery are formed of cast-steel

Casting—In foundry, the running of liquid metal into a mould prepared for that purpose Pig-iron and gun metal are so treated in the manufacture of cannon, iron-work, &c , also in the casting of shot or shell Casting guns is performed by pouring the fused metal into a mould of the shape of the gun required , and in casting what is termed " solid," the fused metal enters in at the bottom of the mould, which is placed in a pit at a convenient distance from the furnace in an upright position, muzzle upwards With reference to the interval that should be allowed to elapse before casting, after fusion takes place, opinions differ Mr Mallet, in his valuable work on the Construction of Artillery, says —" The lower the temperature at which the fluid cast-iron is poured into the mould, and the more rapidly the mass can be cooled down to solidification, the closer will be the grain of the metal, the smaller the crystals, the fewer and least injurious the planes of weakness, and the greatert he specific gravity of casting "

Castle—In a military sense, a fortified place or stronghold, to defend a town or city from an enemy The oldest castles date as far back as the Conquest

Castrametation—The art of regulating and laying out the encampment of troops of all kinds,

Catapult — A warlike machine, used in ancient times for projecting stones, long darts, or javelins There were different kinds and sizes of catapultæ to which names were given The smaller kinds were in the form of a cross-bow , the larger were supported by a frame which sustained two arms moving horizontally, having for a motive force two skeins of catgut The catapult was less powerful than the balista, but more uniform in its range Catapultæ have occasionally been used in modern warfare There was one erected at Gibraltar by General Melville, for the purpose of throwing stones a short distance over the edge of the rock in a particular place where the Spaniards used to frequent, and where they could not be annoyed by shot or shells

Catgut—A cord made from the intestines of animals It is used for turning-lathes and all narrow-grooved wheels in machinery

Cat-o'-nine-tails — A whip with nine knotted cords It is occasionally used in the British service for the punishment of soldiers convicted of heinous crimes

Cat's-paw—Is the name given to a particular turn made in the bight of a rope, in order to hook a tackle to it

Cavalier—In fortification, is a work constructed in the interior of a full bastion Its terre-plein is elevated from eight to twelve feet above that of the rampart, having a parapet of eighteen feet high Its object is to

command some ground within cannon shot, and by its elevation effectually to protect the adjacent curtains from being enfiladed

Cavalli Gun—An iron breech-loading two-grooved cannon, invented by Major Cavalli of the Sardinian Artillery, weighing 66 cwt, its calibre 6½ inches, length 6 feet 9 inches The grooves are cut spirally along the bore, each of them making about half a turn in the length The chamber is cylindrical Immediately behind the chamber, there is a rectangular perforation in a horizontal direction, and perpendicular to the axis of the bore, its breadth vertically is 9½ inches, while horizontally it is 5 24 inches on the left side, and 3 78 inches on the right side This perforation is to receive a wrought-iron case-hardening quoin or wedge, which, when in its place, covers the extremity of the chamber which is nearest the breech The projectile, cylindro-conical or cylindro-conoidal in form, being introduced through the breech and chamber into the bore of the gun, and the cartridge placed behind it, a false breech of cast-iron is made to enter 2½ inches into the bottom of the chamber behind the cartridge, and a copper ring, which also enters the chamber, is placed over it The iron wedge is then drawn toward the right hand, till it completely covers the chamber

Cavalry—One of the branches of the Army, the duties of which are very extended on service, comprising the care of reconnoitring parties, out-post duties, feelers in advance of an army

General de Brack, remarking on the duties of Light Cavalry in the field particularly, but of course applicable to Cavalry of every description, says

"No situation requires so many natural dispositions, such an innate talent for war, as that of an officer of light troops Those qualities which constitute the man of superiority, intelligence, ability, and personal strength, ought all to unite in him Continually left to himself, exposed to perpetual fighting, responsible not only for troops he himself commands, but also for the safety of those he may be ordered to protect and cover, the employment of his faculties, both moral and physical, is called for every moment The profession he follows is a rough one, but his opportunities of distinction occur daily — a splendid compensation, which repays him the more richly for his labours by making him earlier sensible of his value

"To be a good officer of advance guard, it is not enough merely to be brave and to command well under fire it is necessary to have brought there the greatest possible number of men and in the best condition to act with effect This latter part of our indispensable requirement may not be the most brilliant, but it is perhaps of the greatest importance, it is not learnt in quarters, and demands a host of conditions

"The habit of judging of the health of men and horses, a knowledge of prompt remedies applicable in particular cases, the daily and minute inspection of appointments, understanding the necessary and judicious modes of repairing the same, the providing of all that can be useful to the soldier and his horse, without overloading the latter, the equipment well arranged, regularity of pace on the line of march, good situation for the bivouacs, with constant attention to everything which can contribute to the condition of the horse's ability to dispense for a time with the farrier, a notion of the

method of using the utensils contained in a soldier's case, understanding the occasions favorable to refreshment and repose, the moral acquaintance with men under his command, discipline preserved when the dragoons have no longer before their eyes the dread of guard-room or jail, that foresight which ever watches to prevent useless distress to the horses, personal example offered upon every occasion, and afforded the more readily in proportion as those occasions may be trying or difficult, confidence, unbounded devotion, the power of exciting enthusiasm among his followers these are capabilities the theories of peace cannot teach, these are what, in addition to courage, military *coup d'œil*, and a ready judgment on the field of battle, form the officer of real distinction "

The value of Cavalry may be judged not only from our own experience of it, but from the high estimation it was held in in former days James, in his Military Dictionary, says as follows —

"The most scientific and the most experienced officers have always held the Cavalry in high estimation The services which have been rendered by this body of men, their innumerable successes, of which so many records are preserved both in ancient and modern history, together with the unanimous approbation of those authors who are considered as masters in the art of war all these circumstances sufficiently evince, that Cavalry is not only useful, but indispensably necessary, in war Marshal Turenne was known to say —'Avec une bonne cavalrie, on travaille l'armée de son ennemi par détail," meaning thereby, that the desultory and rapid movements of dragoons, if properly managed, are of a nature to destroy the best concerted plans of an adversary, by hanging upon his flanks, driving in his outposts, intercepting his convoys, and by taking advantage of every opening during the heat of engagement The Austrians had a memorable instance of the latter, when the French General Dessain, at the head of a body of horse, decided the fate of the battle of Marengo In pursuits, the superiority of the Cavalry is unquestionable " In the continental campaign of 1870, the Prussian Light Horse seem to have been invaluable (*vide* Uhlan), but the system pursued by both French and Prussians in sending their cavalry regiments against batteries of artillery, seems only to have been fraught with disaster

Cavesson—Nose band of iron, wood, or leather, used for breaking in horses

Cementation—The process pursued in producing steel from pure malleable iron The operation is carried out in placing the iron in troughs with sulphur, salt, charcoal, brick-dust, &c, and exposing the whole to the action of fire in a cementing furnace

Centre of Gravity — *Vide* Gravity

Centrifugal Force—Is that which impels the body to recede from such a centre, if it were not prevented by the centripetal force, this force, according to the first law of motion, impels the body to move uniformly in a straight line

Centring Machine—A machine used previous to boring and turning a piece of ordnance, to find the exact centre of the mass of metal, and there to drill a conical hole at both ends of the gun, which are the centres upon which the gun is turned

Centripetal Force—Is a force which continually tends to draw or impel a body towards a certain fixed point or centre.

Chaco or Shako—The military head-dress of the British infantry

Chain Shot—Consists of two hollow hemispheres, which, when their bases are brought together, enclose a piece of chain which is attached to both hemispheres When the shot is projected, the two parts separate to the distance limited by the length of the chain, and sweep over considerable space They were principally used in destroying the rigging of ships They are now obsolete.

Chalk—Or carbonate of lime, a white calcareous substance, prepared by precipitating a solution of chloride of calcium with carbonate of soda and washing, the precipitated chalk of the pharmacopœia is thus formed Chalk is well known in Europe as an extensive secondary formation In the Arts, it is commonly known as *whiting*, after separating the grosser impurities of the chalk It is used very generally for artillery purposes in arsenal workshops, and for marking the centre and line of metal on ordnance, as well as to mark the position of gun carriages and mortar beds on their platforms, &c

Challenge—In a military sense, is the warning a sentry gives to any person approaching his post after dark in these words —*Who comes there?* At the same time he comes to the charge to prevent any sudden rush upon his post If the reply of the approaching person is satisfactory, the sentry will allow him to pass in these words —*Pass friend, all's well* A similar challenge is made to any person visiting the guards of a garrison or camp during the night, termed Grand (or Visiting) Rounds The term is also applied to the custom formerly of calling another to answer for an offence by combat

Challenging—In a legal sense, and as applied to military matters, is the right a prisoner has of objecting to the President or any other member of a Court Martial If he objects to the President, his objection, unless disallowed by two-thirds at least of the other members, must be referred for decision to the authority by whom the President was appointed, and the Court, if necessary, will adjourn

If he object to any other member, his objection must be decided by the President, and the other members of the Court, other than the one objected to, by vote, the President having a second or casting vote, in case of an equality of votes The prisoner, in making objections, must assign his reasons *Vide* Pipon on Military Law

Chamade— A signal made for parley by beat of drum

Chamber—In gunnery, is a recess formed at the lower extremity of the bore of certain S B ordnance in the direction of the axis, and of less diameter than the bore, to contain the charge of powder Chambers are of two kinds, cylindrical and gomer shape The former are now obsolete in the British service, and the latter (a truncated cone) adopted in all howitzers and mortars, as they admit of the shot or shell fitting closely into the chamber, thus allowing the full force of the charge to act upon the projectile, instead of a portion going past it, as in the cylindrical-shaped chambers. Sir H Douglas, in his 5th edition of Naval Gunnery, remarks as follows on the gomer form chamber "This form of chamber, which was originally intended for mortars, is not well adapted for howitzers or shell guns, which are to be fired horizontally, on account of the difficulty of retaining in their proper places the reduced charges in cartridges,

which do not fill the chambers, and which are liable to slide down the surface of the conic frustum on which they lie, thus causing the gun to miss fire"

Chamfer — An edge, or arris, taken off equally on the two sides which form it, leaves what is called a chamfer or a chamfered edge If the arris be taken off more on one side than the other, it is said to be splayed or bevelled

Chamois Leather—Receives its name from the skin of the Chamois goat, which, in being prepared, undergoes a process of oiling This kind of leather is now made from the skins of deer, goats, and sheep It is also termed *wash* leather

Chape—The metalline part put on the end of a scabbard, to prevent the point of the sword or bayonet from piercing through it

Charcoal—A form of carbon, obtained by burning wood in pits, or by distilling it in iron retorts As one of the great uses to which charcoal is put to is in the manufacture of powder, the following description of the mode of charring the wood will not be uninteresting —Charcoal for gunpowder manufactured in India is produced from the *urhur* or *dhal* stalk (*Cytisus cajan*) by distillation. It is cut up into small lengths, and placed in sheet-iron cylinders termed "slips," which are placed inside thick cast-iron retorts, built in the wall of the charcoal furnace, around which the heat circulates, by this means a regulated heat is applied throughout the operation of charring Each retort, as well as each slip, has two holes in it, for the escape of the gases from the wood, which are conducted by iron pipes into the furnace The method of obtaining charcoal by distillation renders it easy to char the wood uniformly and at a low temperature The time taken to char the first charge of wood, after lighting the furnace, is about 24 hours, and this is in consequence of the cold state of the retorts after they have been allowed to cool down, all subsequent charges take from 3 to 4 hours The slip is then removed, and remains unopened and air-tight from 8 to 10 hours, at the expiration of this period the charcoal is taken out

The good quality of charcoal is known from its jet black velvet-like appearance, and there are other indications, such as its being light and sonorous when dropped It should also be so soft as not to scratch polished copper, and ought not to exhibit any alkali when treated with pure distilled water Twenty-five per cent of charcoal is the general yield from the *dhal* stalk or *urhur* In the Home service, the following woods are made use of for charcoal alder, willow, dogwood In the three Presidencies of India, the best wood as yet obtained for gunpowder purposes is the *dhal* stalk There is also a wood called *jointee* (*Œshynomene Sesban*) which makes a fair charcoal Both woods grow plentifully in Bengal and other parts of India

The charcoal used in arsenal workshops in India is made from a different wood, *sal* (*Shorea robusta*), and charred in pits There is also another charcoal—that made from soondree (*Heritiera minor*)—which gives a great heat, but for that very reason is objectionable, as in fusing metals it cause the earthen crucibles to run into a vitrified state Charcoal is used in workshops by braziers for all work in their line, and by armourers for blueing and blacking sundry parts of the iron mountings of rifles, &c The following test for charcoal is given in

the Hand-Book for Field Service, 3rd edition —(1) "Heat 50 grains of the powdered charcoal in an open porcelain crucible, it should not emit any inflammable gas having the smell of burnt wood Continue the heat until the whole of the charcoal is consumed, the ash which remains should not weigh more than 1 grain, and should be free from particles of sand (2) Boil 50 grains of the powdered charcoal, with a measured ounce of distilled (or clear rain) water in a porcelain dish, for five minutes, the liquid should not impart a brown tint to a piece of turmeric paper, and should scarcely tinge with blue a piece of reddened litmus paper"

Charge—In gunnery, denotes the weight of powder used in each round of ammunition, whether for ordnance or small arms The charge for the several natures of smooth-bored cast-iron ordnance is as follows —For heavy and medium guns about $\frac{1}{3}$, and for light guns, $\frac{1}{4}$ the weight of the shot But, as Captain Majendie observes in his Treatise on Ammunition, it is impossible to give any invariable rule for the weight of the charge in terms of the weight of the projectile, because of the vast number of reduced and exceptional charges, and because, even in the case of "Service" charges, there is, in the majority of instances, more than one of these charges for each nature of gun, according to its weight of metal, or whether it is made of iron or brass

The service charges for howitzers are —

For Iron, $\frac{1}{12}$ weight of shell

For Brass, $\frac{1}{7}$ to $\frac{1}{6}$ weight of shell

In ricochet firing, these charges are greatly reduced—from one-twentieth to one-thirtieth the weight of the shell, but no fixed charges can be laid down, they vary according to circumstances Charges for mortars are demanded as for the maximum charge for the mortars to be fired B L rifled guns have a less charge than smooth-bored ordnance, the Armstrong gun having only $\frac{1}{8}$th, and this arises from the gun having no windage, consequently the whole of the elastic fluid acts upon the shot, and none goes past it There is no general fixed charge for M L rifled guns, such as is laid down for smooth-bored guns, their charges depend on the weight of the shot or shell used, and vary from $\frac{1}{5}$th to $\frac{1}{8}$th the weight of the shot

Charge—In military evolutions, this term expresses the advance of a body of infantry or cavalry to the attack of an opposing force

Charge—In military law, as described in Colonel Pipon's Manual, is the specification of any crime or offence for which a commissioned officer or soldier is tried before a Court Martial The duty of framing the charges against the prisoner devolves upon his commanding officer They must be specific, and not vague or indefinite, and care must be taken that there is sufficient evidence to sustain them—for preferring accusations which cannot be sustained has been declared to be not only inconvenient and prejudicial to the service, but disgraceful to those who bring them forward

All charges may be amended, and additional charges may be brought at any time before the prisoner is arraigned, but not after, and any material variation or omission in the charges may be fatal

The prisoner is to be furnished with a copy of the charges a reasonable time before trial, and if he cannot read, they are to be read to him

Charger — An officer's parade

horse The number of chargers which an officer has to keep up, and for which he receives an allowance, depends upon his rank and the branch of the service to which he belongs Officers of horse artillery and cavalry have to keep up a greater number of chargers than any other branch of the army

Charring—In its general sense, is the application of heat to the surface of timber, in order to harden and protect it from decay

Chase—In artillery, that part of a smooth-bored gun comprised between the front of the second reinforce ring and the muzzle astragal and fillets

Chassepot Rifle—Is a needle-gun, and is now the chief arm of the French service It is the invention of Monsieur A Chassepôt, the chief viewer of the Central Depôt, Paris

To give a detailed description of this weapon would need illustrations to make the mechanism of the lock and breech-piece clear to the reader it is only intended, therefore, to give a general description of the arm It is not unlike the Prussian needle-gun, and appears to be a modification of it, but is said to be superior to it in the closing of the breech, whereas the Prussian rifle is or was defective in this point It has been stated, however, that, in practice, the breech of the Chassepôt is not so well closed as could be desired The Chassepôt rifle is 4 feet 3 inches in length, and weighs a little less than 9 pounds, it has four grooves, with one turn in 21½ inches The accuracy of the rifle is said to be very great at 600 yards It can fire from 6 to 8 shots per minute The objection stated against the Chassepôt is that, after much firing, it becomes so hot as to be inconvenient to handle

The cartridge contains a larger charge of powder than the Prussian cartridge, with a smaller bullet, which is an advantage in favor of the French weapon as compared with the Prussian, in the number of rounds to be carried

From the observations made by a correspondent of the *Pall Mall Budget* during the war between France and Prussia, it appears that the assumed superiority of the Chassepôt over the Prussian needle-gun in actual warfare has been greatly overrated, and what are supposed to be the advantages of the arm have proved, in the day of battle, a source of anxiety and danger to the soldier Its lightness, with its large charge, has the effect of causing great recoil and of heating the barrel The superior range attributed to it induces the men to fire away rapidly on commencing an action, and at such long distances, that, before closing with the enemy, the barrel has become so heated that it is no longer serviceable Further, from the heating of the barrel, the soldier is obliged to fire from his hip, instead of his shoulder, which causes great inaccuracy of aim, worse still, after much firing, the breech arrangement gets clogged, and the arm is useless The cartridge, as in the Prussian needle-gun, does not clear the barrel out each time it is fired, but leaves behind it a thick, fatty, black substance which clogs the breech and renders the piece unserviceable

Doubtless the result of all these faults in the arm of the French service has had a wonderful effect in the war with Prussia, for it is further stated, that the French soldiers have found, after a certain time, that it is impossible to load their pieces, and have in numerous instances thrown away their ammunition

Chasseurs—In the French army, light infantry men, placed upon the left of a battalion or regiment, in the

same manner that grenadiers are posted on the right

Cheeks—The sides of a gun carriage, also termed "brackets" The body of a siege carriage consists of two brackets connected together by three transoms, the trail thus formed being termed a "bracket trail" Bracket carriages were up to the year 1860 used for all siege carriages, but block trails, similar in construction to that for the 18-Pr gun, have since been adopted The term "cheeks" is also applied in fortification to the interior facing of an embrasure

Chelsea College or Hospital—An edifice built on the banks of the Thames, which was originally begun by James I, and intended as a college for a certain number of learned divines The unfinished buildings were afterwards converted, and finally completed, by Charles II, into a hospital for non-commissioned officers and privates who were wounded or maimed in the service, and has remained to the present day a refuge for our worn-out or wounded soldiers

Chemin de Rondes—In fortification, a berm from four to twelve feet broad, at the foot of the exterior slope of the parapet It is sometimes protected by a quickset hedge (a cactus hedge would be better), but in more modern works by a low wall, built on the top of the revetment, over which the defenders can fire and throw hand-grenades into the ditch

Chemistry—As explained in Brande's Dictionary, is a department of science, the objects of which are to investigate the nature and properties of the elements of matter, and their mutual actions and combinations, to ascertain the proportions in which they unite, and the modes of separating them when united, and to enquire into the laws of powers which preside over and affect these agencies As an *art*, chemistry may be traced to a very remote period, but it can scarcely be said to have existed as a *science* previous to the commencement of the 17th century

Chesses — The planking of the platform of a pontoon bridge They consist of two or more planks, wedged together at the edges by dowels or pegs

Chevaux-de-Frise—A species of defence used in field fortification It consists of a square barrel of wood, with strong sharp spears driven through it, in two or more different directions, up to their middle, so as to radiate from it like wheel spokes The present pattern chevaux-de-frise is of iron, barrel, cylindrical the whole consisting of tubes, the spears (twelve in number) being plugged at the ends with points, and packing away inside the barrel The wooden pattern has the advantage of being somewhat lighter, the weight being 96, and 103lbs, wood and iron, respectively The iron has the advantage of greater portability in reference to bulk

Chevron — The distinguishing marks on the sleeves of non-commissioned officers They are worn on the right arm by Cavalry and Infantry, and on both arms by Artillery, Engineers, Fusiliers, and Light Infantry Regiments, in the following order

Serjeant Majors	4 Bars
Serjeants	3 "
Corporals	2 "
Bombardiers 2nd Corporals Lance ditto Acting Bombardiers	1 "

Sergeant Majors, Qr Mr Sergeants, and Orderly Room Clerks, wear their chevrons below the elbow, point down Non-commissioned officers of Artillery wear their chevrons above the elbow, point down

Chime or Chimb—The end of a tub or barrel All powder barrels are ordered to be rolled on the chime as being the safest mode of moving powder either in magazines or mill-houses

Chisels, Carpenter's — Are of different widths and kinds, adapted to different uses, and known as mortise chisels, firmer chisels, socket chisels, &c , and are used not only with a hammer or mallet, but also as cutting tools worked by the hand, for finishing the re-entering angles of mortise holes, or finishing the ends of pieces of wood too small to be planed A variety of chisels are used by the turner as well, who employs them for smoothing and reducing his work to the proper form

Chisels, Firmer—Are flatter and broader instruments than the mortise chisel, varying in breadth from 2½ inches to ⅓rd of an inch, and are used for making tenons, and paring all surface work which requires neatness and accuracy , the operation is performed by the application of the force of the hand or a suitable mallet

Chisels, Mortise—Tools of different sizes, viz , from 1 inch to ⅓rd of an inch in breadth, and are used for cutting the mortise hole for the reception of the tenon

Chisels, Socket—Are a stronger sort of chisel than those described, and adapted for the rougher work of carpenters They are exclusively used with the mallet

Chive — A kind of plane for smoothing the inner surface of the end of a keg or barrel

Chlorate of Potassa ($KO\ ClO_5$)—A salt prepared by passing chlorine slowly through a solution of carbonate of potassa It is a colourless, transparent, anhydrous, crystalline salt It is one of the ingredients in the detonating composition of friction tubes and gun caps It has great oxidising powers, which, when brought into contact with other substances, such as sulphide of antimony, become highly explosive An attempt to manufacture gunpowder from it has been made, but in the act of mixing it with charcoal and sulphur, it was found to explode, and the attempt had to be abandoned

Chloride of Barium ($BaCl \times 2Aq$)—It is used chiefly as a re-agent for the purpose of testing for acids, especially sulphuric, with which it forms the insoluble sulphate of baryta In testing saltpetre, this re-agent is used in searching for sulphates

Chloride of Potassium (KCl)—This salt occurs in sea water, and in the water of many mineral springs It is obtained as a by-product in various processes, particularly in the manufacture of soap and glass, and in the refining of nitre In the latter case, a solution of nitrate of silver is used to detect the chloride, the presence of which is observed first by a milkiness, and on a larger quantity of solution being added, a curdy precipitate of chloride of silver

Chock — A wedge or quoin attached to garrison carriages on which the breech of a gun rests, and is elevated.

Chocks, Friction—Are breaks attached to the common standing garrison carriages so as to raise the trucks or wheels off the platform when the gun begins to recoil, to prevent its running back to any great extent.

Chocking—*Vide* Slewing

Choker, Fascine—Used for bringing the ends of a fascine to the girth, nearly where it is intended the fascine should be, when the fascine is then bound

Chord—In geometry, signifies a line which joins the extremities of any arc of a circle

Chronograph (Bashforth's)—An instrument adapted for measuring the varying velocity of a body in motion through the air, and for other purposes It has been successfully employed in determining the resistance of the air to the motion of spherical and elongated projectiles, varying from 3 to 9 inches in diameter, and a simple instrument has been constructed on the same principle, for use in those cases where the determination of the velocity of a shot at a given point is all that is required (*Vide* Gunnery)

Chronoscope (Navez-Louis' Electro-Ballistic)—An instrument for determining the initial velocity of projectiles This instrument is an improvement or modification of the well-known Navez' Electro-Ballistic apparatus The chief modification consists in the suppression of the conjunctor and the large electro-magnet, which serve to clamp the needle

Another chronoscope has been invented by Captain A Noble, F R S, late R A, for the determination of the time a projectile takes to traverse various intervals within the bore of a gun This beautiful instrument is able to register, by means of electric currents, upon a recording surface, travelling at a uniform and very high speed, the precise instant at which a shot passes certain defined points in the bore In the *Engineer* of the 16th September 1870, a description is given of this instrument, as well as of Rodman's pressure gauge, and also of a pressure gauge invented for the use of the Committee on Explosives, all which instruments were used in determining the pressure of several natures of powder, English and foreign, at certain intervals within the bore of a gun The experiments were most successful, and showed that both "pellet" and "pebble" powder exerted a much less strain on the gun than R L G powder, the latter nearly one-half less

Chuck—Is that part of a turning lathe which is screwed on to the nose of the mandrel in which the work is held or supported, and caused to revolve with the mandrel Its forms are numerous

Chuckler—An Indian term, signifying a cobbler, or worker in leather

Chuttack—An Indian weight, the sixteenth part of a seer

Circle—A plane figure, contained by one line, which is called the circumference, and is such that all straight lines drawn from a certain point within the figure to the circumference are equal to one another This point is called the centre of the circle

Circumference—*Vide* Circle

Circumferenta—A small hand wheel used to measure the circumference of the outside of the felloes, and the inside of the tire of a wheel It is made of sheet-iron, about 8 inches in diameter, with the circumference serrated to prevent it from slipping A line is scratched on the face to serve as an index

Circumvallation—In fortification, works constructed round a besieged place to cut off all communication between the besieged and the surrounding country

Citadel—The stronghold within a fortified place which overlooks the country, and which is generally the last resort of the garrison when the

enemy has got possession of the main portion of the works It is not applicable to modern fortification

Clamp—To fix the movable parts of an instrument by pressure applied to a screw; for example, the vernier, or horizontal and vertical plates of a theodolite, are said, when fixed, to be *clamped*

Clarkson's Material—Consists of cork and canvas cemented together, it is used in the artillery service for cartridge cases for the 12-inch rifled muzzle-loading gun

Claw—Two prongs placed at the end of a hammer or crowbar, for drawing nails and spikes which require force for their extraction

Clay—An adhesive earth, consisting of a mixture, in various proportions, of alumina and silica In foundries it is used for moulding purposes in the manufacture of guns

Claymore or Cly-More—A large two-handed sword, formerly in use among the Highlanders It was originally an English weapon, as appears from the figure of a soldier found among the ruins of London after the Great Fire in 1666

Cleats—Small blocks of wood used commonly for securing movable articles which are likely, as at sea, to roll over or be displaced In the artillery service they are used in different parts of gun carriages for fixing tools, &c

Clinometer — An instrument which is valuable in elevated coast batteries, to ascertain the exact distance of any particular object That invented by Captain J R Oliver, R A, obviates the necessity of a reference to range tables, length of fuze, &c, as all is detailed on the instrument for the nature of the gun

Clipper, Portfire—The name given to the cutting implement which is fixed on the off-side of the beam trail of a gun carriage, for cutting off the lighted end of the portfire Portfires being no longer in use, except on emergency, and having been superseded by friction tubes, the sockets and cutters are ordered to be removed from all artillery carriages

Clocks, Mill—Used in gunpowder mills to indicate the number of revolutions made in a certain time by the "runners" in the incorporating process These clocks differ considerably from common clocks, and are only used for the purpose stated

Cloth—In arsenals, this material is much used, and is of various kinds —*viz*, book muslin, buntin, canvas, doosootie, serge, vitry, waxed cloth The cloths enumerated are made use of for the following purposes.—Book muslin, for the bottom of sieves, &c; buntin, for colours (*vide* Buntin), canvas, as shown under that head, doosootie, in capping carcasses, and it is also occasionally used for package and in making blowing bags, serge, for service cartridge bags, vitry, which is a fine kind of canvas, for making paulins and powder cloths; occasionally for 13-inch blowing bags, sponge caps, and gun aprons, also for saddle wrappers, waxed cloth, for powder barrels (one and a half yards being required to pack a powder barrel in), and for wrapping round elevating screws, fuzes, &c

Clove Hitch—Termed also the *cascable hitch*, is a well-known knot in the artillery service; it is used in mounting and dismounting guns, capping fuzes, tying cartridges, &c

Club—In military evolutions, to throw into confusion, to deform, through ignorance or inadvertency To club a battalion implies a temporary inability in the commanding officer

to restore any given body of men to their natural front in line or column.

Coal—Is a mineral of vegetable origin It is thus described by Sir C Lyell "When wood and vegetable matter are buried in the earth, exposed to moisture, and partially or entirely excluded from the air, they decompose slowly, and evolve carbonic acid gas, thus parting with a portion of their original oxygen By this means they become gradually converted into lignite or wood coal, which contains a larger portion of hydrogen than wood does A continuation of decomposition changes this lignite into common or bituminous coal, chiefly by the discharge of carburetted hydrogen" The coal chiefly used in India in the Government arsenals and factories for steam engines, is obtained from the Raneegunge and Beerbhoom mines, about 120 miles from Calcutta Smithy coal, which is used for all cast-iron work, is imported from England Anthracite coal is also brought from England, and is used chiefly in the Government powder works, alone, or mixed with steam coal It produces no smoke, and therefore may be used with safety in a powder factory, besides, it contains a greater quantity of carbon than any other coal

Coast Batteries — Are batteries erected along a coast to protect the entrances of harbours and ports They are armed with artillery of the largest calibre to oppose the landing of an enemy

The nature of ordnance for coast defences was in 1860 recommended to be as follows —

The 10-inch gun of 86 cwt
" 68-Pr " of 95 "
" 8-inch " of 65 "
" 32-Pr " of 56 "
" 13-inch Sea Service mortar.

Now that rifled artillery have been introduced into the service, and armour-plated ships have to be opposed, these guns have been supplemented by the heaviest rifled ordnance

Coat-of-Mail—Armour made of scales or iron rings

Coating—Is the covering of any material with paint, lacquer, &c, and is applied to ordnance, as well as to shot and shell, internally and externally For the coating of ordnance, *vide* Paint

Cockade—This military badge, or mark of distinction, is a ribbon formerly worn in the hat In the armies of Europe, this mark succeeded the scarf which was worn by officers and soldiers, but being found to be attended with inconvenience, it was to a great extent discarded In the army and navy of Great Britain, the officers were distinguished by black silk ribbon, and the non-commissioned officers, privates, and mariners, by hair cockades This fashion has, for some years past, fallen into disuse, and the cockade is now only worn by a military or naval officer's servant

Code, Military—A collection of rules and regulations which have been sanctioned by authority, for the better government of the army—such as the Articles of War

Coehorn Mortars — Light mortars of 5½ and 4⅖ in calibre, having cylindrical chambers The 5½ in mortars of this nature are obsolete in the British service They were introduced by the great Dutch engineer of that name.

Cogs — In machinery, the teeth raised on the surfaces of wheels

The term *teeth* is usually applied to the cogs on the surface of the large wheel, and *leaves* to those on the surface of the small wheel in contact with it, usually called a *pinion* The number of times the pinion revolves while the

wheel makes one revolution, will be evidently equal to the number of teeth in the wheel divided by the number of leaves in the pinion Let T = number of teeth in the wheel, t = number of leaves in the pinion, and N = number of revolutions made by the pinion while the wheel makes one, or if R, r be the respective radii of the wheel and pinion, then—

$$N = \frac{T}{t} = \frac{R}{r}$$

Cohesion—The power of transmitting heat or electricity, without change in the relative position of the particles of the conducting body

Cohort—The tenth part of a Roman legion, which consisted of 600 men

Coil—Applied to the form rope is wound in and issued from the manufactory A coil of rope, as received into arsenals, contains 120 fathoms

Coil of a Gun—Made by winding a hot bar of iron round a mandrel, *which is afterwards removed* The rough coil so formed is then welded, bored, and turned to the required size In building up a gun, Sir W Armstrong uses a succession of these wrought-iron coils, shrunk on to a tube or barrel of steel or iron, and to him is due the credit of being the inventor of this system But since his original plan of thus building up a gun, an important modification of it has been made by Mr Fraser, attached to the Gun Factory, Woolwich, who, by using a few long double or triple coils, instead of several short single ones and a forged breech-piece, which is Sir W Armstrong's system, has effected an immense saving in time and expense

Coir—The fibres of the cocoanut Very excellent rope for naval purposes is made from it, on account of its lightness, elasticity, and strength Coir *cable is prepared in Ceylon,* on the Malabar Coast, in the Maldive and Laccadive Islands, and in most places along the Eastern and Western Coasts of the Bay of Bengal, where cocoanut trees grow Sponges for guns have been made from the fibre, but it is not equal to wool for this purpose, and is, moreover, liable to take fire

Coke—Fossil coal deprived of its extraneous volatile matter by fire It is sometimes used in combination with coal, where a greater degree of heat is required than coal alone affords In furnaces for melting pig-iron, kentledge, and other metals, it is the chief fuel used It is manufactured at the coal mines in Bengal, but the best is inferior to English

Colback—A busby, or hussar cap

Colic—A complaint with which horses are not unfrequently attacked, caused by indigestion, constipation, spasm, strangury The attack will generally yield to the first or second dose of the usual colic mixture, with injections of warm soap-and-water, and with a little spirits of turpentine in it, friction being used to the surface of the belly If there is constipation, give a dose of physic, with a tea-spoonful of ginger in it, if the pain continues and becomes more constant, bleed, taking from six to ten quarts of blood, continue the injections, and give a dram of opium every hour, blister the belly, clipping the hair off first The cure for colic is powdered opium, 1 dr , ginger, powdered, 2 drs , allspice, powdered, 3 drs , carraway seeds, powdered, 4 drs , made into a bolus

Collar—That part of the harness which encircles the horse's neck, and to which the hames are attached, and by means of which the draught is applied to the animal The term is also applied to other parts of the harness,

and to portions of metal work about a gun carriage, as well as to certain parts of machinery and artillery material

Collar Makers—Artificers attached to each light field battery for the repair of its harness On first appointment, they have the rank and clothing of bombardiers, and reckon service, as such, without increase of pay After five years' service, if a bombardier, they have the rank and clothing of corporals, and reckon service for pension, as such, without increase of pay The four senior collar makers of each brigade are allowed the rank and clothing of a sergeant, but without increase of pay

College—In the common acceptation of the term, is a community of students assembled together for instruction, if the instruction be of a military nature, it is termed a Military College The community is bound together by rules and regulations common to all Such is the college at Sandhurst

Collimator—That invented by Lieut-Colonel Davidson, late Bombay Army, for the artillery service, is an instrument for laying guns and mortars, and especially adapted for laying them for night firing But the same appliance as is used by night could be made available by day, with the embrasures closed, thus protecting the gunners from the fire of the enemy

This instrument was introduced into the service in 1863 General Lefroy, R A, approved of it very highly, and Captain Moncrieff, the inventor of the barbette carriage, considered it as very valuable for laying mortars

Colonel of a Regiment—A general officer placed at the head of a regiment, as a reward for long and meritorious services, and though he does not command the regiment in person, the command being honorary only, he has certain privileges attached to the position, and his sanction is required on some points having reference to the discipline of the regiment As Colonel of a regiment, he draws "Colonel's allowance"

Colonel, Brevet — An officer holding a Colonel's commission, but not necessarily, or of right, in command of a regiment Should he, however, be the senior Lieutenant-Colonel, he commands the regiment in his own right

In the artillery, regimental Colonels command their brigades, the Lieutenant-Colonels commanding divisions or detached portions of artillery

Colonel Commandant—The chief of a brigade of artillery, engineers, or marines This position is analogous to that of a Colonel of a regiment, who receives what is termed the "Colonel's allowance"

Colours — The banners or flags carried by regiments of infantry There are two flags carried by a regiment, the royal or first colour, and the regimental or second colour, on the former are the badges and number of the regiment, on the latter, the devices, distinctions, and mottoes which have been conferred by royal authority, the whole ensigned with the imperial crown Crowned heads, princes, and marshals are alone entitled to be saluted by lowered colours The colours of a regiment are always saluted by guards The banners of a dragoon regiment are called *guidons*, and those of other cavalry regiments, *standards*

Colours, Camp—For marking out the lines of a camp They are 18 inches square, and of the colour of the facings of the regiment

Columbiads — American ordnance of the calibre of 8 and 10-inch, for firing shot or shell

Column—The formation of troops in deep files and narrow front, so disposed as to move in regular succession In artillery, the column formation is in sub-divisions, divisions, and half batteries The object of this formation is to reduce the line of frontage of troops, and to give facility in manœuvring

Combat—A battle or duel Anciently it was not uncommon for contending powers to settle their dispute by single combat, when each party chose for itself a champion who contested the point at issue in the presence of both armies

Command — In fortification, when several works cover the same ground, the difference of level, when one work is higher than another, is called the *command* of that work over the other When this difference of level is sufficient to allow of both works to fire at the same time upon an enemy's advance, one over the other, it is termed a *command of fire* But when the difference of level is only sufficient for the inner work to look into, and act upon the interior of the outer one, it is called a *command of observation*

Command — The authority in chief exercised by the senior officer of a regiment or of any body of troops

Commander—An officer having superior authority over others

Commander-in-Chief—The chief military authority in a country, in whom is invested the supreme command of the army The Commander-in-Chief of the British troops is appointed by the Sovereign

The Commander-in-Chief in India is also appointed by the Sovereign, but is subordinate to the Commander-in-Chief in England.

Commissariat — The supply department of the army, upon which devolves the responsibility of collecting all provisions, forage, &c , necessary for troops in cantonments, or in the field

This department, in England, has lately been re-organised and placed under the Control Department

Commissary — This term was used in the old French service to express a variety of military occupations, as it is in the British service at the present day , the officers attached to the Ordnance and Commissariat Departments are called "Commissaries" In the Ordnance Department, an officer in charge of, or attached to, an arsenal in India, is termed a Commissary of Ordnance

Commissary of Ordnance— The departmental title given to an officer of artillery who has charge of an arsenal in India Each officer, on being appointed to the ordnance department, remains on probation until he has passed an examination in the various subjects appertaining to the charge of an arsenal, such as accounts, the nomenclature and use of stores, the working of metals, &c , when, if found qualified, he is posted to the department For the duties attached to the office of Commissary of Ordnance, *vide* the Ordnance Codes of each Presidency

Commission — In a military sense, the warrant authorizing an officer to exercise command in the army Commissions are given to cadets from Sandhurst, with or without purchase, depending on individual proficiency Cadets who are educated at Woolwich receive their commissions either in the Artillery or Engineers without purchase In the upward ranks of the cavalry or infantry, commissions are purchased, except in the case of death-steps, which fall to the senior of each

grade In the Artillery and Engineers, commissions cannot be purchased in any grade of an officer's service Commissions, a few years ago, received the Queen's sign-manual, but an Act has been passed dispensing with this necessity

Committee—*Vide* Board

Common Shell—*Vide* Shell

Communications—In a military sense, are the lines by which an army communicates with its base from any point to which it has advanced in the theatre of war, along which its reinforcements and supplies must pass to reach the army, and by which it must retreat in case of disaster The definition applies equally whether the army occupies an extended strategical front, or is united on the field of battle

Company—In the army, means a body of men forming one of the principal divisions of a regiment The number in a company varies according to circumstances, but may generally be said to be about 100 A company is commanded by a Captain, and has two subalterns attached to it In the artillery service, the term *company* is exploded, and the word *battery* has taken its place

Compass, Scribe—In artillery, an instrument used for laying off the distance of the centre of the trunnions from the base ring

Complement—In trigonometry, the difference between any arc and a quadrant of 90°

Compressed Bullets—Are bullets formed of compressed lead The mode of compressing is as follows.—The lead is first melted, and then raised from the reservoir in a bucket by a small crane, and poured into the receiving chamber of a hydraulic press of immense power. A piston rising from below, and worked by a pump, is set in motion by a steam engine, and when the lead is cooled down to the proper temperature, it is forced through a die, forming it, as it escapes, into rod lead, which winds itself on to a drum of about the diameter of the required bullet It is then carried on to the bullet machine, where it unwinds and divides itself as the machinery revolves, and is guided to a cutting apparatus, which nips off a cylindrical piece of lead, as the piece falls down it is caught by a punch and die, fixed exactly below, forming it into a perfect bullet in one stroke The object of compressing the lead instead of casting it, is to give density to the bullet and to prevent air holes forming within it

Compression, Globe of—A surcharged mine, so called from its compressing or disturbing effects beyond the sphere of its crater

Compressor—A brake or check attached to a gun carriage Its controlling power is great; this is particularly the case in Colonel Clarke's Hydraulic Compressor attached to ships' carriages, both with regard to recoil, and also for keeping the carriage immovable on the ship when there is much pitching

Comrade—A fellow-soldier in the same regiment or company

Concave—Hollow, such as the inner surface of a sphere, as opposed to its outer, which is termed convex

Concentric—Having a common centre The internal hollow sphere and the external figure of the outside of a shell are concentric spheres

Concussion—A substantive used as an adjective in connection with the word "fuze" It is best represented in Saxon English by the word "shock" The concussion fuze has an internal

mechanism, so nicely adjusted as to withstand the first shock which the shell receives,—*viz*, that occasioned by the explosion of the charge,—and resisting others that may be occasioned by grazing short, while it will yield to the *concussion caused by the impact* of the shell on the body struck This concussion, by shaking the burning composition of the fuze into the loaded cavity of the shell, instantly causes the latter to explode Armstrong's fuze as well as Moorsom's in the English, and Billet's in the French, Naval Service, are instances in point

Condensation—Is a term applied to the liquefaction of gases By the application of pressure, and reduction of temperature, most gases may be condensed to the liquid or solid state

Condenser—An instrument for forcing a large quantity of air into a given space It consists of a receiver, a cylindrical barrel furnished with a valve opening inwards, and a solid piston, which is either air-tight or has a valve also opening inwards Near the top of the cylinder, on one side, there is a small orifice The principle of this instrument, which is nothing more than a force-pump, is this, that when the piston is forced down the cylinder, the air contained in it opens the valve at the bottom, and a barrel of common air is forced into the receiver On raising the piston, the bottom valve closes, and when the piston rises above the orifice near the top of the cylinder, the air rushes in and fills the barrel again This process is repeated as long as is necessary

Condensing Engine—Called also a low-pressure engine, is one in which the steam is condensed so as to present nearly a vacuum on one side of the piston, while the steam is acting on the other As the pressure of the air on a vacuum is about 15 lbs on the square inch in a condensing engine, the pressure of the steam in the boiler need not be so great as it necessarily has to be in a non-condensing engine, where the pressure of the air has to be *overcome before any effective force can* be obtained Hence condensing engines are called "low pressure," while non-condensing are called "high pressure"

Conductors — Warrant officers attached either to the Ordnance or Army Commissariat Departments Those in the former department in India are chiefly men who have risen from the artillery ranks The warrant rank comprises the following grades sub-conductor, conductor, deputy assistant commissary, assistant commissary, and deputy commissary The three latter are strictly departmental, and carry with them honorary rank, and are held also by commissioned officers holding unattached rank Advancement is obtained by rotation in the Ordnance Department, each man entering first as a magazine sergeant, promotion afterwards being to the warrant grade of sub-conductor, if duly qualified, which is ascertained by the candidate undergoing an examination under the orders of the Deputy Inspector General of Ordnance

The term "Conductor" was originally given to warrant officers, from the fact of their conducting stores by land or water to the several arsenals or magazines in India

Cone—When the extremities of a straight line, which always pass through a fixed point, are made to trace out circles by revolving around this point, the two surfaces described are each called a conical surface, and the volume enclosed by each surface is called a *cone* The circle described in each case forms the base of the cone on its

side of the point, the fixed point through which the line passes is termed the vertex, and the line joining the vertex with the centre of each base is termed the axis When the axis is at right angles to the plane of the base, the cone is called a *right cone*, otherwise an *oblique cone*

Cone, Truncated, or Frustrum of a Cone—Is a cone with a portion at the vertex cut off by a plane parallel to the base

Confidence—This term, in a military sense, has reference to the facility with which some officers gain the confidence of their men This most essential quality in a commander is of the highest importance, and cannot be overrated,—without it, a disaster may at any moment occur in the day of battle, but with it, and the knowledge of military science combined, success in the operations of an army may be assured History affords examples of battles having been lost by the most celebrated generals, because they did not possess this confidence

Congreve Gun—A 24-Pr gun of conical form, this gun was proposed in 1813 by Sir W Congreve, it had a much greater thickness of metal at the breech than those of the old construction, the extra thickness was supposed to give a reacting power to the gun, which, however, is an erroneous idea not supported by facts

Conjunctor—One of the three principal parts composing Navez' Electro-Ballistic Apparatus It is thus described by Captain Noble, late R A, in the R A Institution Papers, Vol 3, page 117 —

"The current which passes through the second screen holds, by means of an electro magnet, a weight suspended over a spring, a point from which is kept just over a cup of mercury When this weight is permitted to fall, it presses the point into the cup of mercury, and completes the circuit, magnetizing the horse-shoe magnet which clamps the vernier needle This part of the apparatus is termed the conjunctor The action of the instrument is very simple, and readily understood When the projectile cuts the wires in the first screen, the magnet which holds the bob of the pendulum in its initial position is demagnetized, and the pendulum commences an oscillation When the wires in the second screen are cut, the weight of the conjunctor drops, completes the circuit, clamping the vernier, and the arc through which the pendulum has moved is a datum from which may be computed the corresponding time"

Conoid—A figure generated by the revolution of a *conic section* about its axis It is, therefore, three-fold, answering to three sections of the cone, —*viz*, elliptical-conoid or spheroid, hyperbolic-conoid, and parabolic-conoid

Conscription — A compulsory enrolment of the inhabitants of a country for service in the army In England this is not resorted to In the French army the conscription has been established since the first Revolution, and all citizens are liable to it at the age of 20 There is, however, an exemption from it on furnishing a substitute

Conscripts—Men raised by most of the Continental nations, and under certain laws, to recruit their armies The Militia of Great Britain comes likewise under the appellation, with this difference, that the men are raised by ballot, and do not march out of their native country unless they volunteer to do so.

Constipation — In horses, is brought on from confinement, too little

water, dry feeding The symptoms are, belly swelled, dung dry and hard The cure is, mashes or green meat, clysters, and exercise.

Contingent—In a military sense, implies the quota of armed men, or *pecuniary subsidy, which one State* gives another

Contouring—A term applied to the outline of any figure, and consequently to that of any section of a solid body, but when used professionally, in connection with the forms of ground or of works of defence, the outline of a horizontal section of the ground of works is alone to be understood by it

Contraband of War — All such articles as a neutral power is prohibited by the law of nations from carrying to countries at war with one another, such as arms, ammunition, coal, food, &c, or to carry on any trade with blockaded ports or besieged towns All the articles enumerated above are liable to be seized, and are considered contraband of war The subject of what is contraband of war is so arbitrary, and depends so much on the interpretation given to the term by powerful States, able by force of arms to dictate what is contraband, that it renders the position of neutrals and belligerents to each other one of great difficulty One thing, however, should be remembered, that there is a great difference between carrying contraband articles *to* the belligerents, and allowing either of them to buy such articles in a neutral territory

Some authorities support the principle that it is neither beneficial nor expedient for England to prohibit the export of arms and munitions of war to belligerents, and amongst them Lord Penzance, no mean authority on such a subject *Vide* his letter to the *Times*, dated 18th October 1870

Whatever the opinions on contraband of war may be, the Foreign Enlistment Act renders it illegal in any person to enlist in the service *of a foreign State, or to build* any ship with intent or knowledge that the same will be employed in the military or naval service of any foreign State at war with any friendly State; and special powers are granted to the Secretary of State to take any step to prevent the commission of such an act

Contraction—The state of being drawn into a narrow compass, or becoming smaller. In horses' feet, it is brought on from bad shoeing, hot stables, confinement The foot becomes oblong, instead of round The remedy to be applied should be thin sole and quarters, and the feet kept moist. Apply tips or spring shoes, also tar or hoof ointment composed of tar and tallow, each 1 lb, common turpentine, ½ lb, melted together

Contravallation—The name given to a belt of field works thrown up around and facing the place invested, to render the besiegers secure against surprise

Control Department—Is a newly organized department in the British army, having for its object a better, more efficient, and more economical control over the departments it supervises

The Commissariat and the Ordnance Departments are the main sources of supply to an army, the former representing the food or life of it, the latter, its fighting resources

Without thorough efficiency in these departments, no army can exist in the field, failure would probably entail defeat and all the disasters attend-

ing it We have an instance in the Franco-Prussian war of the disasters likely to attend an army whose commissariat is unequal to the demand upon it—in the case of the French army at Sedan—which, it is said, from want of proper commissariat arrangements, was unable to effect the relief of Metz, and was consequently overwhelmed by the Prussian army

Contusion — The effect of a ball or of any other hard substance striking the human frame, or even the passage of a ball close to the limb, without breaking or tearing the skin

Convention — An agreement which is entered into by troops that are opposed to one another, either for the suspension of hostilities or the exchange of prisoners

Conversion — A term used in ordnance nomenclature when condemned stores are converted or turned into use for other purposes

Convex—*Vide* Concave

Convoy—A guard of troops composed of all arms, employed to escort any supply of money, ammunition, stores, provisions, &c, conveyed in time of war to an army or fortress

Copal—A resin next in durability to amber, almost colourless, and softer than amber, though too hard to be scratched by the nail Copal forms an excellent material for varnish Pure alcohol has little effect on copal, with the addition of camphor it dissolves, but the camphor impairs the durability of the varnish Copal may be perfectly dissolved by ether, but it evaporates too rapidly to allow of the varnish being uniformly applied Copal is, therefore, usually dissolved by fusing, and adding linseed oil heated nearly to the boiling point.

Coping Stone—*Vide* Cordon

Copper—A metal of great value, and known from the earliest ages It is found in different parts of the world, and in combination with other substances, as an ore The great supply to the English market comes from the mines in Cornwall, Devon, Australia, and from South America To bring copper to a state of purity, it has to go through successive repetitions of roasting, calcining, melting, and refining, and this is chiefly carried out at Swansea in South Wales, where there are large smelting furnaces It is used as an alloy with many other metals, and with tin in the manufacture of bronze guns Copper alone is a very malleable metal, but on being mixed with tin becomes tough and well suited for the lighter natures of ordnance. Copper melts at a temparature of about 2000° Fahrenheit It is a good conductor of electricity, and is, therefore, made use of for lightning conductors

Copper Rod—Used for the lightning conductors of magazines Conductors are made either solid or tubular, varying from half an inch to two inches in diameter, being three inches in length, and screwed to one another. They are supposed to protect a circular space, the radius of which is double the height of the rod

Copper Scissel — The clippings of copper left after the formation of percussion caps, friction tubes, coinage, &c

Copper, Sheet—Is of two kinds, thick and thin The former comprises all copper of and above 50 ounces to the square foot, the latter, all under this weight Thick sheet copper is used for the hoops of powder barrels, and for drying pans, the thin for percussion caps, friction tubes, &c, and the lining of magazine doors Muntz' patent metal is a cheap substitute for copper sheeting

Cordage—The term applied to every description of rope used in the artillery service *Vide* Rope

Cordon—A round projection of stone, about one foot in diameter, placed at the top of the revetment of the escarp to prevent the rain from damaging the masonry, and to form an obstacle to the besiegers when applying the ladders for the purpose of an escalade

Core—A bar of iron coated with clay, which is inserted into a finished gun mould, when the gun is to be cast hollow, which is termed "casting on a core" This mode of casting guns is not now adopted in the British Service In the United States Service, it has again been reverted to, the practical difficulties that hitherto interfered with this mode of casting having been surmounted by Captain Rodman, of the United States Ordnance Department A core is also used in casting shells

Cornet—The junior rank amongst officers in the cavalry branch of the service The cornet's duty was formerly to carry the standard—but it is now carried by a troop sergeant-major

Corning or Granulating—That process in the manufacture of gunpowder which takes place after the cake is removed from the hydraulic press—having been previously broken down—to the granulating house, when it is passed through rollers and sieves, until the different sized grains are formed Corning is another term for granulating

Coronet—That part of a horse's foot termed the little pastern, just above the coffin bone

Corporal—The rank below that of serjeant Corporals of artillery take precedence of corporals of cavalry and infantry, according to the date of their appointment as Bombardiers

Corporal Punishment—The infliction on the bare back, by means of a cat-o'-nine tails, of a certain number of lashes for crimes committed by soldiers Except for very grave offences, such punishment is seldom resorted to in the army, and then only during war times The number of lashes is limited to 50

Corps—Any body of forces destined to act together under one commander

Corps-d'armee — *Vide* Army

Corrosive Sublimate—Is the bi-chloride of mercury It is formed by introducing hot mercury into chlorine gas, the mercury inflames, and the bi-chloride is formed There are other ways of preparing it What is termed kyanising, is applying this substance to the preservation of timber, cordage, sail, tent cloths, and other fabrics from decay by mould, or the ravages of insects It is the invention of Mr Kyan

Corrugate—A mode of rendering sheet iron very tenacious and durable The sheet iron is coated with zinc, and compressed by means of dies into plates This kind of iron is extensively used for roofing, for military wagons, boats, &c

Corselet—A light armour for the fore-part of the body, or, according to some authorities, it was a mailed coat made to cover the whole body It was anciently worn by pikemen

Cossacks—As described in Brande's and Cox's Dictionary of Science and Literature, are a people inhabiting those parts of the Russian empire which border on the Northern dominions of Turkey, Poland, and the Southern confines of Siberia Both the name and origin of this people are involved in great uncertainty They seem to have none of the national character s-

tics of the Russians, and are probably a mixed Caucasian and Tartar race They form a sort of independent republic, paying no taxes to Russia, but cheerfully contributing their numerous and valuable contingent of men, which are well known as the most harassing light troops that ever exercised a predatory warfare in the train of any army

Cottah—A Madras weight, equal to 16 chuttacks

Council of War—In the field, or elsewhere, an assembly of the senior officers of the army, called together by the officer in command, to concert measures for the future conduct of affairs

Counterforts—*Vide* Buttresses

Counterguard — In fortification, is a reveted work consisting of a narrow rampart and parapet, parallel to the faces of the bastion, and which must be destroyed before the bastion can be breached, for, from want of sufficient breadth in their terreplein, a lodgment cannot be effected in them by the enemy Counterguards are sometimes constructed before the salients of the ravelins

Countermarch—A change by wings, companies, and sub-divisions, whereby those who were on the right take up the ground originally occupied by the left, and *vice versa*

Countermines—Are mines or galleries excavated by the defenders of a fortress, to intercept the mines and destroy the works of the besiegers

Counterscarp—In fortification, the revetment of the ditch forming the support of the covered way, opposite the escarp

Countersign—A watchword or number given daily by the commander of an army, in order that friends may be distinguished from foes by the knowledge of it, and which is exchanged between guards, and entrusted to those employed on duty in camps or garrison Before the enemy, the countersign must be given by every one who approaches a sentry's post

Coup-de-main — Sudden and successful attack on any position.

Coup-d'-œil—A glance, a prospect, its military signification is the art of distinguishing at first sight the weak points of an enemy's position, and of discerning the advantages of which any given space of country is susceptible

Court Martial — A military court appointed under the provisions of the Mutiny Act, for the investigation and punishment of all offences committed by officers and soldiers There are three natures of Courts Martial, viz, the General, District or Garrison, and Regimental, the assembly of either of which depends on the enormity of the offence to be tried On a march, or on board ship, a Detachment Court Martial may be convened by the senior officer in command

Cover—To soldiers who have seen much campaigning, this term will be familiar, as expressing security or protection, thus, to land under cover of the guns, is to advance offensively against an enemy who dares not approach on account of the fire from ships, boats, or batteries It likewise signifies whatever renders any movement imperceptible, as under cover of the night, under cover of a wood, &c

Covered Way—In fortification, is a space about thirty feet broad from the counterscarp to the crest of the glacis, and completely surrounding the body of the place with its outworks, thus forming a secure road of commu-

nication all round the fortress, outside the ditch.

Crab Capstan—Consists of a barrel (in shape a frustrum of a cone) and frame-work of wood and iron, by which the barrel is supported in a vertical position with its base next the ground It is furnished with two levers, called capstan bars, which are passed through mortises in the head, and by means of which the barrel may be turned about on its axis By means of the crab capstan, a few men acting at the bars can move weights which would be far beyond their strength, if applied in the ordinary manner If a crab capstan cannot be procured, the windlass of a gyn may be used as a substitute, the cheeks being laid on the ground and secured with pickets, or a temporary capstan may be rigged, by lashing four handspikes to the spokes and felloes of a limber wheel, which is turned upon the pintail of the dismounted limber

Cradle, Gun—A frame-work of wood placed on the back of an elephant for carrying Field or Mountain Artillery in hill countries This mode of transport is chiefly for field guns, as mountain guns are generally carried on the backs of mules An elephant can carry 1,400lbs, but in a hilly country his load should not exceed 1,000lbs

Cramp—A short bar of iron with its ends bent, so as to form three sides of a parallelogram at one end a set screw is inserted, so that two pieces of metal being placed together, can be held firmly by the screw

Cramp Knife—Used by the cooper for shaving a stave

Crane—A piece of mechanism usually consisting of combinations of toothed wheels and pulleys, by means of which stores, materials, &c, are lifted from vessels to the yard or wharves Cranes are of two kinds, fixed and moveable In the former case, they are much more efficient, as greater power, by the interposition of wheels, axle, and pulley, can be applied Fixed cranes at wharves are generally made to revolve on a centre, so that the goods raised can be brought over the wagon into which they are to be deposited The smaller cranes are from 3 to 5 tons, that is, capable of raising those weights

Crank—In machinery, is a bend in an axle by which a reciprocating motion in a rod is made to produce a revolving motion of an axle and of a wheel, which may be connected with it

Crater of a Mine—The cavity formed in the ground by the explosion of a charge of gunpowder or gun-cotton.

Crease, Iron—One amongst the many irons the tin-man makes use of It is employed for making small bands and tubes, and also for creasing up, and thereby strengthening the edges of articles

Cremaillere—An indented or zigzag outline

Crenellated—Loop-holed

Cresset—A skeleton grate used by the cooper for bending staves The grate is filled with chips or shavings and lighted, the keg or cask is then placed over or round it, and when the sap is warmed, the staves will bend without cracking

Crose—An instrument used by the cooper for making grooves

Cross—The ensign, or grand standard, borne by the crusaders in the Holy Land Hence is derived the name given to the superior mark of distinction termed the Grand Cross belonging to certain orders, such as the Bath, Star of India, St Michael, and St. George

Cross-lifting — To cross-lift a gun is to move it in a direction nearly at right angles to its axis

Crow-bar—An iron bar, used as a lever to move heavy weights

Crown-Work — *Vide* Horn-works.

Crow's Foot—An iron ball with four spikes, so arranged that when thrown on the ground, one spike always remains upright It is used to impede the advance of troops, more particularly cavalry The spikes are sometimes cast without a ball, and sometimes they are simply triangular pieces of iron with the points sharpened

Crucible—A melting pot used in the chemical laboratory Small crucibles made of earthen-ware should be made to stand great heat, as when residuum has to be burnt, the crucible is put into the fire or over a lamp

Crusher Gauge—An apparatus expressly designed for the use of the Committee on Explosives, lately assembled in England, for the purpose of determining the pressure of all natures of powder on the barrel of a gun For a description of the apparatus and its use, *vide* Proceedings of the Royal Artillery Institution for November 1870

Crust — The internal part of a horse's foot which covers the more sensitive parts of the foot, and to which the shoe is immediately attached

Crystallization—The spontaneous arrangement of the particles of solid bodies in regular geometric forms A tendency to such an arrangement is generally observed in solids which are gradually deposited from a state of solution, but sometimes in those which have condensed into the solid from the gaseous form, or in masses solidified after fusion

Cube—A regular solid body with six equal sides and containing equal angles

Cuirass—A piece of defensive armour covering the body from the neck to the waist The household troops (cavalry) wear the cuirass at the present day

Cuirassiers — Heavy cavalry, still kept up in some of the continental armies There has been no such regiment in the British Army, since the Revolution in France The French had troops of this description in the campaigns of the first Napoleon, but notwithstanding their supposed invincibility, they were totally routed, and destroyed by the superior weight and dexterity of the British Life Guards

Cul-de-sac — A place where troops are enclosed, and at the mercy of the enemy

Culmination—In astronomy, is the act of coming to the meridian in the case of any star or planet, when it attains on any given day its greatest altitude in the heavens

Culverin—Ancient name of a gun , it was at first the lightest and shortest, but afterwards the longest and heaviest gun

Cunette—A narrow wet ditch in the middle of the dry ditch of a fort It acts as a drain, as well as an impediment to an attacking force It is generally about 6 feet wide and 3 or 4 deep

Cupola—A revolving shot-proof turret, formed of strong timbers, and cased with massive iron plates , either one or more of these turrets or towers are placed on the upper deck of a ship, and in some systems of cupolas the tower is erected on a base which is made to turn on its centre by means of steam power The weight of one of these towers of the late Captain

Coles's pattern, including guns, would be about 68 tons Within the turret, heavy ordnance is placed, and fired through openings made in the sides

The term cupola is also applied to a small blast furnace in which iron is melted It consists of a cast-iron cylinder, lined with sand or fire bricks, with openings at various heights in the side, for admitting the blast pipe where it is wanted Near the bottom is an opening for letting out the liquid metal The furnace is first filled with ignited coke, and as this begins to sink, alternate charges of coke and pig-iron are thrown in every ten or fifteen minutes

Cups, Tin—Are used with heavy breech-loading guns, and serve, in conjunction with the vent piece, to seal more effectually the powder chamber, and to prevent the escape of gas, which is very destructive to the angular face of the vent piece The cup is placed between the end of the cartridge and vent piece A small hole in it serves both for the passage of the vent fire, and also for the cup being easily placed in position There are two sizes of tin cups, the low and high gauge Low gauge cups only are required for guns with iron breech bushes The cup should be drawn out to the rear by means of a hook

Curb—Is the wooden or iron border, funnel shaped, standing out from the incorporating bed of a gunpowder mill at an angle of 45 degrees, and 2 feet high, serving to keep the charge in the bed, and all extraneous matter out of it This term is also applied to a horse's bit Also to the enlargement on the back of a horse

Curry Comb—Used in cleaning a horse. This instrument should never be applied below the knee, as it is calculated to injure the back sinew.

Curtain—In fortification, the line of rampart that joins the flanks of two bastions together

Curtain Angle—In fortification, formed by the meeting of the flank and the curtain

Curtains—The targets used by artillery at practice are termed "curtains," and are made of coarse Indian canvas of the following dimensions, 9′×9′ In India, two per piece are allowed to a Light Field Battery, one per piece to a Heavy Field Battery, ai eight curtains in all to a Mounta Battery Artillery Divisions get cu tains 9′×9′ at the rate of two per piec except for mortars, and curtai 36′×12′ (one on loan) are to be expen ed for heavy howitzers

Curve—The line described by projectile in its course, termed *trajectory*, which being acted upon gravity, does not move on in a hori tal or straight line, but incline bends towards the earth

Curve Line—Is a line whic neither straight nor composed straight lines Of special curves, th described by a projectile is the only one that need be considered here in connection with gunnery It is called the *trajectory*, and approximates closely to a parabola

Curved Fire—When a projectile is fired so as just to clear an interposing cover, and then descend upon the object, the line of fire being perpendicular, or nearly so, to the front of troops or works to be destroyed,—such practice has been termed "curved fire," in order to distinguish it from ricochet This kind of fire has been long employed to dislodge troops posted behind cover, by firing common shells from guns or howitzers Smaller charges and higher angles would, as in ricochet, be required than for ordinary direct fire

Curvilinear—Consisting of curved lines

Cutlas—A broad curved sword used by sailors

Cutters — Implements used in workshops, also in foundries in boring ordnance They are classed under several heads according to the work they are required to perform

Cylinder—When one extremity of a straight line is made to revolve round the circumference of a circle, so all the positions of the straight line parallel to each other, and the other emity describes an equal and parallel ircle, the straight line generates indrical surface, the volume en d by which circle is called a *cylin-* The line joining the centres of cle is the axis of the cylinder, *right* when the axis is at right to the circles or bores, otherwise

nder Gauge — An instrument vented for gauging the dimensions f the cylinder of a smooth-bore The gauge must pass to the bottom of the cylindrical part of the bore , if it does not go freely to the bottom, the bore is too small , but if it goes down, the bore may still be too large and irregular in its dimensions To ascertain this the " star gauge" is used A cylinder gauge is turned to the exact minimum or true diameter of the bore for each calibre This cylinder is hollow, of wrought or cast iron, and its length is equal to its diameter It has cross-heads at right angles to each other, one with a smooth hole of the same diameter as the cylinder staff, the other tapped for the screw of the staff socket.

D.

Dagger—A short sword or long knife It was in vogue as early as the sixth century, and has been in constant use since Midshipmen still carry it in their dirk

Dahlgren Gun—Is the invention of the late Admiral Dahlgren of the U S Navy In appearance, the gun is not unlike the shape of a soda water bottle In this gun every projection that can be dispensed with is suppressed, and the exterior form is produced by a continuously curved line, no angular points being formed by suddenly changing the diameter at the different points along the piece The U S Navy guns of this pattern are the 9-inch, 10-inch, and 11-inch shell guns

Dam—An impediment formed of stones, gravel, and earth, thrown across a stream of water, by which it is made to overflow its banks, in order to inundate the adjacent country

Dammer—A resinous substance found in many parts of India, it exudes from different kinds of trees That used in Bengal is yielded by the "*Shorea Robusta*" or the Sâl tree. There are three kinds, the white, black, and coarse dammer, which appear to resemble the resin obtained from the pine It is in very general use throughout Eastern and Southern Asia. In arsenals, it is used to protect packages, &c , which are likely to be exposed to damp or wet in transit

Dart — A lance thrown by the hand This weapon is only known in ancient military history

Day, Apparent Solar — Is the time included between the centre of the sun leaving the meridian of any place, to its return to the same meridian again It varies continually in length, owing to the unequal motion of the earth in its orbit, and the obliquity of the ecliptic, being sometimes more and sometimes less than 24 hours

Day, Artificial — Is the time

between sun-rise and sun-set, and varies with the latitude of places

Day, Astronomical — Is reckoned from noon to noon ; and, consisting of the same length of 24 hours in all latitudes, is called a natural day

Day, Mean Solar — Is the time which would elapse between consecutive returns of the sun to the meridian of any place, if moving in the plane of the equator with an equable motion. It is the mean of the true solar days throughout the year, and consists of 24 hours as measured by a time-piece, which, on some days of the year, is as much faster than the sun-dial, as on other days the sun-dial is faster than the time-piece

Day, Sidereal — Is the time which elapses between consecutive returns of any fixed stars to the same meridian, or in other words, the period which the earth takes to accomplish one rotation on its axis This period is unvarying and immutable—23 hours, 56 minutes, 4 seconds, which would always be the length of the solar day, if the earth stood still in space, and only turned upon its axis

Dead-Head—In foundry, the mass of metal in excess of the gun's length, which is purposely left in casting ordnance It serves to replace the diminution or contraction of bulk which takes place in the cooling of the metal, also to add solidity and compactness to the piece The longer the dead-head the better Before the piece is bored out, the dead-head is cut off, and re-melted with subsequent castings.

Deblai—In fortification, earth excavated from the ditch to form the *remblai*

Debouch—To march out of a defile, or narrow pass, or from a wood, village, &c.

Debris—Ruins of a building or town which has been sacked ; broken remains of an army after defeat.

Decamp—To quit any place or position in an unexpected manner

Decantation—In chemistry, a mode of separating solids from fluids It consists in allowing the solid to subside to the bottom of the vessel, and removing the clear supernatant liquid by pouring it off slowly

Declination — Of a heavenly body is the arc of a circle of declination, intercepted between its place in the celestial concave and the celestial equator

Decrement—The diminution of any quantity, space, or time.

Decrepitation— In chemistry, the crackling noise which certain salts make when heated, usually caused by the sudden escape of water

Defaulters' Book—Is the record of crimes committed by soldiers There are two Defaulters' Books in a Regiment, the Company and the Regimental In the former are inserted punishments for minor offences, not exceeding 3 days, which can be awarded by the officer commanding the company Such punishment should be inserted in the officer's own handwriting In the latter, or Regimental Defaulters' Book, are inserted all punishments awarded by the Commanding Officer of the Regiment, or by Courts Martial In this book are also to be entered all offences for which a punishment exceeding 7 days' confinement to barracks has been awarded

Defilading—In fortification, is the proper arrangement of works in order to parry the effects of commanding ground Works should be defiladed against musketry, within 400 yards , and against artillery, within 1,200 yards or upwards This was the distance with smooth-bore arms, which has

probably been modified since the introduction of arms of precision.

Defile—A narrow passage or road, in marching through which the troops can present only a small front. If artillery, on its march, is opposed by such an obstacle as a defile, or a steep ascent in mountain passes, &c, the head of the column must endeavour to pass it rapidly, and the drivers of the succeeding carriages should be warned of it, that they may be attentive to keep their distances and ranks

Deflagration — A chemical term it is understood to mean every process of decomposition attended with noise or detonation

Deflection of a Projectile—*Vide* Deviation.

Degree—The 360th part of the circumference of a circle, 60 geographical miles

Deliquescence — The power that certain salts have of attracting moisture and dissolving into water Saltpetre has generally many deliquescent and impure salts in it, which, in the process of refining, it is freed from, before being used for gunpowder purposes

Demi-Bastion — In fortification, that which has one face and one flank cut off by the capital

Demi-Lune—In fortification, a work having two faces forming a salient angle A ravelin is a demi-lune

Demolition of Artillery—The destruction of ordnance by artificial or other means This is performed, if the gun be an iron one, by half filling the piece with powder, and jamming in one or two shot with stones, bits of iron, &c.; over this a complete tamping with stones and earth till the bore is filled. To break off the trunnions is not always an infallible mode of destroying ordnance, as they can still be fired from the ground. When time admits of only crippling guns partially, by removing one of the trunnions, this is best done by laying its end on a block of wood, the blow being given by a sledge hammer, or (if that be not at hand) by heavy shot A shot may be fired at the gun behind one of the trunnions, which, if it should not break it, would render it unsafe The first method, however, particularly if the muzzle is partly buried in the ground, will be found certain to burst the gun To render bronze guns unserviceable, fire a shot into them from some other piece, behind the trunnions, which will prevent the possibility of their being used again

Demolition of Works—When there is time, this operation is performed by mining or blasting. Thus, for instance, in demolishing the revetment wall, shafts would be sunk along the back at certain intervals (usually two or three lines of least resistance), the charge being placed within two or three feet of the bottom These charges are all fired simultaneously by a proper arrangement of the hoses, or by an electric battery If a house, such as a magazine, block-house, &c, has to be demolished, it would be done by blasting In this case, blast-holes, having an inclination downwards, are bored in the walls at two or three line intervals as before When the charges are required to be large, it is customary to bore the holes crossing each other in the shape of the letter V or X When there is very little time, and the work has to be done hastily, the demolition is performed by firing large charges of powder, placed in the most effective manner In a bridge, for instance, a large charge placed over the crown of an arch, the roadway having been previously picked up, would cause certain demolition; or in a building, two or three

large charges placed against the walls in the rooms, the doors and windows being shut, would destroy the house

Densimeter—An instrument for determining in mercury the specific gravity of the grains of gunpowder The one in general use in the Government Factories was invented some years ago by Colonels Malet and Barthelmy Bianchi, of the French Artillery Before the introduction of this instrument, the density of powder was arrived at by the immersion of the grain into liquids, such as turpentine alcohol, &c , but no method has proved so accurate or satisfactory as mercury

The mode of taking the density is as follows First exhaust the air within the globe or receiver, fill it with mercury, weigh it, and empty the globe Then take 100 grammes of powder, which is the usual quantity employed, and introduce it into the globe Exhaust the air again, and admit as much mercury as the globe will now contain, weigh this, and note down each weighing, *viz*, the globe filled with mercury, and the globe filled with mercury and powder Having accomplished this, proceed by the following formula to find the actual density of the powder

$$D = \frac{D \times 100}{(P' - P) + 100}$$

Where D = specific gravity of mercury, which is found from a table of specific gravities of mercury at different temperatures,

P = weight of globe filled with mercury and powder,

P′ = weight of globe filled with mercury alone,

100 = weight of powder used

The following is an example

	Grammes
Globe and mercury only .	4190
Globe with powder and mercury	3495

Temperature at the time of weighing the mercury 60° Faht., consequent specific gravity 13 59

$$\text{Then } \frac{13\ 59 \times 100}{4190 - 3495 + 100} = \frac{1359}{795} = 1\ 709$$

density required

Density—The density of a body indicates the quantity of matter in it under a given bulk, and is synonymous with the term "specific gravity"

In the manufacture of gunpowder it is very necessary to attend to the density, as so much depends upon this all-important point in regulating the quality and strength of the powder Experience has shown the density, most likely, under certain circumstances, to produce a good result in the different natures of powder manufactured, and care must be taken that neither an excess or want of density is apparent, as in the former case it affects the initial velocity of the powder, if great pressure has been given to it, causing thereby a low initial velocity, and again want of density renders the powder quick in ignition, which tells with great force on the gun, so as to render the use of such powder unsafe

Deploying—The formation of a body of troops from column into line

Depot—A place of receipt and issue of Commissariat and Ordnance stores In small garrisons, depots are usually in charge of Warrant Officers of those Departments The name is also given to certain companies at Home belonging to Regiments on Foreign Service, which are formed into battalions under officers specially appointed to command them

Depression Carriage—A garrison carriage which admits of a depression of 30°

Depth—In military evolutions,

applied to the space taken up by troops in column Also the ground occupied by a Battery of Artillery in column, and its depth when drawn up in line on parade.

Derivation—In gunnery, a term used by the French to express the deviation, to the right or left of their path, of elongated projectiles, fired from rifled guns

Derrick—A sort of crane, principally used on board ship in hoisting heavy weights, such as taking out or putting in a mast. If used on land, it consists of a beam of wood, one end resting on the ground, the other supported at any convenient angle by guys

Deserter—An officer or soldier who, while on duty with his regiment, leaves it without permission, with the intention of not returning to it again The Articles of War punish desertion with death, but the power is only exercised before the enemy

Any soldier absent without leave for more than twenty-one days must be tried for desertion by a Court Martial

Desiccation—The expulsion of moisture from solid substances This is effected at various temperatures, according to the nature of the substance, and by different means, such as the water oven, air bath, &c

Detachment—A body of troops, varying in number and composition, according to the nature of duty required It remains with the general of a force to form the detachment of whatever troops he may see fit, and to use it as he may think necessary

Detachment, Gun—Consists of a certain number of men told off for the service of each piece of ordnance In the exercise of the various descriptions of ordnance, the same numbers, as far as possible, always perform the same duties, the detachments being told off upon the same principle, viz , beginning with the lowest numbers and proceeding to the highest, No 1 always commanding Not less than six men should be posted to any description of ordnance, and this number is only sufficient for light field pieces Heavy ordnance detachments vary in number according to the size and weight of the piece The Armstrong Field Guns have detachments of one non-commissioned officer and eight gunners For the heavier natures of Armstrong guns, such as the 40-Pr and 20-Pr , one non-commissioned officer and nine gunners form the detachment, and increased numbers to the still larger natures of rifled ordnance

Detonating Composition—A term applied to certain highly combustible compounds, which, when suddenly struck, ignite or detonate Such is the composition used in the manufacture of percussion caps, friction tubes, Pettman's fuzes, and the composition placed at the base of the Martini Henry cartridge A detonating fuze is now used in firing compressed gun-cotton, and its application in this manner is a recent and very valuable invention

Deviation—In gunnery, the path or course projectiles take oblique to the line of direction, caused, for the most part, from windage, and the non-homogeneity of the shot or shell, as well as from the friction and shocks which the projectiles experience during their passage in the bore, and which form the principal causes of irregularity in fire from smooth-bore guns Rifled guns giving a right-handed rotation, and from which elongated projectiles are fired, have a small constant *deviation* to the right, but which can be allowed for in laying the gun, a horizontal

slide being graduated and attached to the vertical tangent scale of the Armstrong gun for this purpose, or the gun can be sighted "true" when manufactured, so that no allowance is necessary except for wind This deflection or *derivation* in rifled guns arises most probably from two causes *First*, a shot rotating rapidly, and at the same time falling in the air, will experience a greater pressure underneath than above, and will, therefore, roll, as it were, upon the denser air below; and if on leaving the piece it had a right-handed rotation, would roll to the right *Second*, the resistance of the air on the point of an elongated shot fired with a right-handed rotation, will act obliquely on the shot and cause deflection to the right

Devil Carriage—A carriage on high wheels, with a limber similar to that of a siege carriage, for the transport and removal of heavy ordnance It is not used in India, and appears in the Home Service to have been superseded by the sling carriage

Dhall Bush (*Cytisus cajan*)—The wood used in India in the preparation of charcoal for Gunpowder It grows in most parts of India, and has been found to make the best charcoal of the several woods at present known Colonel Anderson, in his work on the 'Manufacture of Gunpowder,' mentions it thus "Dhall Bush has a growth of a few months, the seed is planted in April and the grain ripens about the 1st January the next year, when the bushes are cut down The stalks are brought and stacked for use at the Powder Works The wood is white and soft, and contains much saccharine matter. Hence, insects breed internally, while externally it is attacked by various moths, which deposit their larvæ. The charcoal is good, its fibrous texture distinct, and it rings with a clear, metallic sound, being at the same time soft and friable A beegah of Urhur, or Dhall wood, is calculated to give about 200 maunds of wood in its yearly crop, or the charcoal for 160 barrels, hence 10,000 barrels would require a yearly cultivation of 60 beegahs"

As a general rule, the wood should be stripped of its bark previons to charring, although the practice was not uniformly pursued in the Indian Powder Manufactories in former years, owing, it is supposed, to the expense, and perhaps, the importance of peeling the wood not having been realized The peeling process is now strictly carried out

Dhurree—An Indian term, for a coarse kind of cotton carpet, called also a *satringee*, it is used for the flooring of tents, and very generally for carpets in most houses in the North-West Provinces of India. They are made in different parts of the country, and very often by prisoners in jails A small satringee is issued by the Commissariat Department to every European soldier, which is placed on his sleeping cot in barracks, on the march, his bedding is folded up in it.

Diabetes — This complaint in horses, as explained in Small's Veterinary Tablet, is brought on from "too strong diuretics, or bad hay The symptoms are, increased flow of urine, great debility The cure is rest and warm clothing, with a physic ball composed of Cape Aloes, from 6 to 10 drams; Castile soap, 1 dram, spirits of wine, 1 dram, syrup to form the ball. Also an anodyne ball may be given, composed of opium, 1 dram, camphor, 2 drams, ginger powder, 1½ drams, treacle to form a ball"

Diagonal — Is a straight line

which joins the vertices of two angles which are not adjacent to each other

Dial, Sun—A plate of metal or stone on which are inscribed the hours of the day, in such a manner that the shadow cast from the gnomon erected upon it, which falls in a direction always opposite to that of the sun, shall indicate the apparent time The gnomon represents the axis of the earth, hence its angle with the horizon is the latitude of the place, and it lies in the plane of the meridian The hour lines are the projections of the horary meridians, given by the intersections of their planes with that of the horizon or dial Dials may be placed either vertically or horizontally The better class of dials have the equation of time for all the different periods of the year marked on the face At outposts and other remote places, where there are seldom any clocks, and it is difficult to obtain a tolerable approximation to correct time, a dial will be found very useful

Diameter — A line passing through the centre of a circle, bounded at each end by the circumference When great accuracy is not required, the proportion of the diameter of a circle to the circumference may be taken as 1 to 3 1416 To find the diameter of a spherical shot, its weight being given, multiply the cube root of the shot's weight by 1 923 for the diameter In taking the diameter or calibre of the bore of a rifled gun, it is measured across the *lands*

Diaphragm Shell—*Vide* Shells

Dickson's Guns—These guns were designed by the late Sir A Dickson, R.A, they comprised some light 32 Prs, 24 Prs, and 18 Prs for naval service, which are now nearly all obsolete.

Dies—Are tools used in cutting metal screws or bolts, and are the converse of the tap as they must have internal instead of external threads, but the radial notches are essential alike in each For small works, the internal threads are made of fixed sizes, and in thin plates of steel, such are called "screw plates" For larger works, the internal threads are cut upon the edges of two or three detached pieces of steel, called "dies" These are fitted into grooves within "die stocks" and various other contrivances which admit of the approach of the screwed dies, so that they may be applied to the decreasing diameter of the screw, from its commencement to the completion

Difference — A term which is only known in the British army It is the sum paid by an officer, when he exchanges from full to half pay It likewise means the regulation price between an inferior and a superior commission

Dip—The inclination or set of the arms of axle-trees of gun carriages

Dipping Needle—Consists of a magnetic needle, supported and balanced on a horizontal axis, and playing therefore in a vertical plane The angles through which it turns are indicated by a graduated circle, the centre of which coincides with the axis of the needle, and the frame which supports it has an azimuthal motion round a vertical axis, which is indicated and measured by the graduated horizontal circle

Direction — In gunnery, is the path or course a projectile takes when fired from a gun If the projectile travels to the point upon which the gun is directed, the direction is commonly said to be "good," if it swerves away to the right or left, the direction is then said to be "bad"

Disarm—The act of depriving

a soldier or body of troops of their arms for some gross misconduct or crime which renders dismissal from the service necessary The mutiny in India of 1857-58, affords instances of whole regiments being disarmed and disbanded Other regiments, though apparently loyal, were simply disarmed, to prevent the chance of an outbreak upon their officers, with the intent to murder them

Disband—In a military sense, applied to the dismissal of a regiment or any large body of men, from the conditions of their military service, for disaffection or treasonable conduct

Discharge—In gunnery, to fire off a piece of ordnance Guns were formerly discharged by priming powder poured into the vent, or by quick match, which was ignited by means of slow match or portfire, friction tubes have, for some years past, been introduced into the Service, and have been found to be vastly superior in power and certainty of ignition to either of the above modes, and are now universally used

Discharge—In the army, a release from Military Service There are several sorts of discharge First, on a soldier having completed his term of service for which he engaged, and not wishing to renew his services Second, when permitted to purchase his discharge Third, when disabled from wounds or sickness to serve any longer Fourth, when discharged by sentence of court martial to penal servitude

Discipline—As understood in military life, is the obedience to and exercise of all orders and regulations, which have for their object the good government and management of a regiment or army In fact, discipline may be defined as the perfection of order and regulation in an army. To it, in the management of troops, may be attributed in the day of battle much of the success which has attended the arms of a nation Without it, an army becomes a rabble, and though bravery will do much towards achieving success, it is by discipline mainly that the object of a war can be ultimately attained

Discretion — As explained in Johnson's Dictionary, includes prudence, wisdom, the liberty of acting at pleasure, uncontrolled and unconditional power ; all which qualities, if wisely directed, will contribute much, in military affairs, to the successful termination of all undertakings The military phrase, *to surrender at discretion*, implies surrendering without stipulation, throwing one's self on the mercy of a victorious enemy

Disembody — A term used in military parlance to signify the disarming of any body of men, and in dispensing with their military services for any stated period The disembodying of the militia is an instance in point

Disengage — In machinery which is in motion, to lift a wheel *out of gear*

Dish—The inclination or angle with the nave given to the spokes of a gun wheel, which is about 1½ inches

Disjunctor — One of the three principal parts composing Navez' Electro Ballistic Apparatus It is thus described by Captain Noble, in the R A Institution Papers, Vol 3, page 117

" An important part of the apparatus (the disjunctor) remains yet to be mentioned It will be obvious that the arc we have just supposed to be measured, corresponds to the time which the projectile takes to pass over the distance between the screens, plus the time which the weight of the conjunc-

tor takes to fall from its initial position to the cup of mercury Now to obtain the former, the latter of these times has to be subtracted from the reading of the instrument, and the disjunctor enables us to do this by permitting us to break both currents (those through the first and the second screens) simultaneously The mode of procedure is then as follows The instrument being arranged, the two currents are simultaneously broken by means of the disjunctor, and the reading of the needle is recorded The instrument is again adjusted, and the projectile fired, the velocity of which it is desired to determine, and the reading of the needle again noted, the former are is subtracted from the latter, and the corresponding time computed It will be observed that, by the use of the conjunctor, any constant source of error (such, for example, as the error due to the time required to clamp the vernier needle) is eliminated, as the same error will occur both in the disjunctor and the projectile reading, and by subtraction will disappear The disjunctor also enables us to ascertain the degree of regularity with which the instrument is working, as the accidental variations of the reading corresponding to the time, are of course the same as the variations which would occur in the reading corresponding to any other time Major Navez lays down, as a rule, that observations should not be proceeded with when in a series of ten or twelve disjunctor readings there is between two successive readings a difference greater than 0° 25 "

Disk or Disc—A circular plate of any sort.

Dislodge—In a military sense, to drive an enemy from the position he has taken up

Dismantle—In a military sense, to render fortifications incapable of defence

Dismissal — Is the sentence passed upon an officer by a Court Martial, for conduct which renders him unfit to remain in the army From the date of publishing the order, the dismissed officer's connection with the army ceases It is in the power of Her Majesty to dismiss any officer from the service without bringing him to trial

Dismount—In artillery, to take a piece of ordnance off its carriage With light guns, it is performed by the gun's crew with the aid of drag ropes With heavy guns, gyns have to be resorted to, but guns of moderate weight can be dismounted by means of tackle, rollers, and handspikes

Dispart—In gunnery, the dispart is generally defined as a patch of metal placed on the highest point of the muzzle of a gun or howitzer, and which is half the difference between the diameters of the base ring and that of the swell of the muzzle This definition, as Major Owen remarks in his Lectures on Artillery, will only strictly apply to cast-iron and bronze ordnance He further explains that most of the *dispart sights* or *patches* are not placed near the muzzle, but on the top of the gun, a little in advance of the trunnions, or, as with B L rifled guns, just above the trunnion A better definition for dispart would then be, —half the difference between the diameter of those parts of the gun upon which the sights are placed The term is derived from the mode of ascertaining the dispart, as shown above, and disparting (dividing in two) the difference between the two diameters, which *half* difference shows the tapering or coning of the metal

between the base ring and swell of the muzzle This patch of metal is intended, in laying the piece, to avoid the inconvenience arising from the line of sights or metal not being parallel to the axis of the gun Disparts are either fixed or movable

Disperse—In a military sense, is the power which an armed body, either better handled, or in larger numbers, has of scattering a hostile force drawn up to oppose it Cavalry, under these circumstances, form a prominent part in pursuing or dispersing the enemy

Disposition—As applied to the strategic position of troops is of infinite consideration both in war and in time of peace In the former case, a knowledge of the country in which the campaign is to be fought, and the various combinations which should be carried out, formed on the disposition of the troops, is very necessary on the part of the general in command, to bring matters to a successful termination, or to prevent the enemy from taking advantage of a bad disposition of his opponent's forces to harass or break them up The following maxims from the memoirs of General Montecuculi are worth remembering —

"Deliberate leisurely, execute promptly

"Let the safety of your army be ever first.

"Leave nothing to chance

"Take advantage of circumstances

"Use all the means in your power to secure a good reputation"

Distance—The space between the observer and any object. In gunnery, to judge distance accurately is a high qualification in artillerymen, as it is also in soldiers of the line, and is only to be attained by a clear sight, constant observation, and practice in the drill laid down on this subject, termed "judging distance drill," the introduction of which into the army has been attended with such excellent results Under the most favorable circumstances, however, judging distances by the eye is not to be depended upon, and this is so much felt in the artillery service that guns will soon have measuring instruments attached to them, which will give the distance of objects very accurately, and render it unnecessary to depend on the eye Captain Nolan's range-finder for this purpose is most favorably spoken of

Distance—In drill, is the relative space left between men in the ranks after a formation or movement; or the space between ranks closed or open

Distillation — The separation of a body from extraneous substances by its conversion into vapour, its removal in that state, and its subsequent condensation The operation is termed *distillation* if the vapour assumes the form of liquid upon condensation, even if that liquid should solidify upon further cooling The vessels used for distilling are few and simple, those for raising the temperature of the water are generally of metal, and termed "stills" A still consists of a boiler to contain the liquid, to which is adapted a head terminating in a beak, which fits into the condensing apparatus There are two forms of condensers in general use,—the Worm, and Liebig's Condenser

District—In a military sense, is the division of a country into separate military commands, which are so disposed that the troops shall be within easy hail of each other and susceptible of being readily combined

Ditch—The excavation or trench made round the works of a fortification, from which the earth necessary for

the construction of the rampart and parapet is raised. Ditches are either wet or dry The latter are preferred, as admitting of a better means of defence

Diving Bell - A vessel inverted in water and let down to any depth by means of a rope, air occupying the upper part of the vessel By means of the diving bell, men are able to descend to great depths, and to carry on such submarine operations as may be necessary in masonry, laying stones, and the like, keeping under water for some hours by the aid of fresh air supplied by pipes or barrels attached to the bell

Division—In Artillery, a portion of a Field Battery, consisting of two guns with their wagons, a division of artillery is also represented by two or more batteries under the command of a Lieutenant-Colonel

Division of an Army—Consists of two or more brigades, composed of the three arms of the service, or of one arm alone, commanded by a General Officer

Dog Tire—An instrument used in drawing the hot tire on the wheel It consists of a bar of wood, about 2 inches square and 3 feet long There is an iron catch with a turned-up end, about 9 inches long, which works either on a pin or an eye-bolt, let into the wooden stick To use it, the end of the stick is placed under the felloes, and the iron catch over the tire, and the handle pressed downwards

Dog Wood (*Cornus sanguinea*)—Wood from which charcoal is made in the Royal gunpowder factory, Waltham Abbey, for R F G powder It is not grown in any great abundance in England, and is therefore imported into the country from the Continent. In private factories, the charcoal commonly used for R. F G powder is the alder (*Rhamnus frangula*) and not dog wood

Dolphins—Two handles or rings in the form of an extended horse-shoe on the surface of ordnance, midway between the breech and muzzle They were formerly cast on bronze guns, and were found useful for lifting the gun out of its carriage

Donjon or Dungeon—The highest and strongest tower of an ancient castle Derived from the Celtic word '*dun*,' a height It was sometimes the resort of the garrison when nearly worsted, in order to offer terms of capitulation, it was also used for the reception of prisoners

Donkey Engine — A small steam engine, which is in very general use when stores have to be lifted On board ship it is invaluable for clearing the hold

Doolie — An Indian term a stretcher for carrying the sick and wounded in India It is composed of a frame-work of wood, the seat or flooring of cane or nawar (a coarse cotton tape) At the head and foot of the doolie is a triangular frame of wood, to the top of which an iron ring is attached, through this the bamboo for lifting the doolie is placed, and raised on the shoulders of the carriers The top of the doolie has a light frame-work of wood, over which a coarse red cloth curtain is hung to exclude the sun and wind from the patient

Double-Shotting—This is a practice more often adopted with naval than land artillery In the latter, double shotting is only resorted to when the enemy being close on the guns, a double charge of case shot is likely to render good service In double-shotting, the shot should touch each other A wad is useless between them, rendering the shot more liable to split than if they

were in contact The charges for double-shotting should be very much reduced, and the largest sized guns should not be fired at a greater distance than 4 or 500 yards It is forbidden in the navy to double-shot the 10-inch gun or 8-inch of 52 cwt, and all carronades The 32-Pr of 56 and 58 cwt may be fired treble-shotted, and are the only guns that may be so fired with safety up to 200 yards

Dovetailing—In carpentry, a method of fastening or joining two boards together by letting one piece into another in the form of the tail of a dove, projecting bits in one board being cut to fit into corresponding hollows in the other

Dowelling—In carpentry, forms part of a joiner's work, and is the mode pursued by the joiner in joining planks or boards together, which is done thus viz, by inserting short pieces of hard wood, let in for half their length, into a mortise cut in the edges of the boards that are to fit together, the mortises being, of course, made opposite each other, the dowels preventing the boards from rising up or starting from their places when the work is finished Instead of short dowels, a strip the whole length of the boards is let into each joint, half the strip lying in a ploughed groove made in the middle of the corresponding edges of the two boards, but beside these precautions, the joints are well glued up In making or repairing wheels, dowelling is resorted to by inserting or letting into the ends of each pair of felloes a round piece or pin of tough wood, serving to prevent their deviation from the circle, when by pressure of the tire or any other force, all the ends are compelled to meet Dowelling is also applied to the manufacture of heads of barrels or casks.

Dowlas—A coarse kind of linen which is used in a saltpetre refiner for filtering the saltpetre liquid as i is drawn off from the boilers

Drag Rope or Lever Hitch—A knot, the same as the men's harnes hitch, and used for fixing handspike to the ropes attached to heavy car riages, which are to be moved by men three men to each handspike

Drag Ropes—Used in mov ing ordnance carriages when in diffi culty, in sandy soil, steep ascents o descents, where there is no shoe attach ed to the carriage, or locking chai used for holding upon the carriage They are made up in arsenals, th chain end is intended to prevent th rope being cut by the tire of the wheel

Dragon's Blood—A deep re resinous substance found in the Eas Indies, Cochin China, and the Easter Islands It occurs in masses of vari ous degrees of purity, and in stick enveloped in palm leaves Dragon' blood is employed as a colouring mat ter, and as an ingredient in varnishe Formerly it was used in arsenals in th browning liquid for gun barrels, but ha been discontinued for some years

Dragoons—Were formerly term ed a kind of cavalry, from their serv ing indifferently on foot or horse, an thereby enabled on an emergency t act as cavalry or infantry The were armed at first with a pike an musket, but the sword was afterward substituted, and gradually the Dragoo ceased to act on foot The first regi ment of Dragoons was raised in 1681 and called the Royal Regiment o Dragoons of Great Britain—now th *Scots Greys*

Draught—In a military sense any given number of soldiers take from the different branches of th army, or from the different componen

parts of a regiment or brigade for any particular service

Draught—The act of drawing or pulling carriages, military or other kinds This subject is of the highest importance in the artillery branch of the service, where the whole transport of artillery *matériel* is dependent on draught cattle Horses for this purpose form the chief draught Those for the artillery service should never be less than 15 hands high, certainly not the wheel horses, for height tends very much to the capabilities of a draught horse, and as explained in Hyde's Gunnery on the subject of draught "In four-footed animals, the hinder feet is the fulcrum of the lever by which their weight acts against the load, and when the animal pulls hard it depresses its chest, and thus increases the lever hence we see the benefit that may be derived from large horses for their lever necessarily increases with their size Large horses will draw more than small ones, even though they have less muscular force and are unable to carry such a heavy burden The force of the muscles tends only to make the horse carry forward continually his centre of gravity, or in other words the weight of the animal produces the draught, and the play and force of the muscles serve to continue it"

In India, though horses form the draught of field artillery with their ammunition wagons, heavy artillery, with the rest of the *materiel* of the army, are drawn by elephants and bullocks

Draw—In gunnery, to "draw the charge," is to remove the cartridge from the piece after it has been loaded, and which is generally effected by means of the "worm" attached to the rammer head of the sponge staff

Draw-bridge — In a fortified place, the communication with the country and between the various works is kept up by means of gateway, bridges, posterns, &c Where bridges are used they are always broken by draw-bridges, which can be raised in a moment of emergency and are usually drawn up every night by order of the Governor of the place

Draw-knot—A knot in common use in the artillery service It is used for the same purpose as the reef knot, *viz*, for joining two ropes together

Drawing, Military — The representation or delineation on paper by vertical or horizontal lines of any portion of a country, the features and extent of which it is necessary a General in command of troops, serving in an enemy's country should be made acquainted with The best instruments for military sketching are the prismatic compass and pocket sextant

The information which such a sketch would afford, should be supplied by the Quarter-Master General's Department, every officer of which ought to be able, with or without the aid of mathematical instruments, to delineate with facility and correctness a rough sketch of the peculiarities of the country

Drawing Paper- For the different sizes, *vide* Paper

Dress—To dress, in manœuvres, is to keep the company or battalion in such a position or order, as to make an exact continuity of any line or direction on which it may be formed In dressing, the men turn their eyes to the "*point d' appui*," where the officer is posted, and by his correcting the alignment on certain fixed points, the most perfect line may be obtained In artillery, when a column is wheeled up into line, the dressing is made on the heads of the markers' horses, and six inches from them The same rule is

to be observed in all formations of line, as well as in the correcting of a line, when it is necessary to throw out markers for that purpose In action, the dressing is on the axle-tree of the gun on which the formation is made

Dress—In casting, implies the removal of the clay from a piece of ordnance when withdrawn from the pit, preparatory to turning

Dress, Military—The clothing issued to the army, termed regimentals The dress of the soldier should be light and easy, not encumbering his arms or legs in any way but leaving him free to shoot or walk The dress, moreover, should be adapted to the climate of the country in which the soldier serves

Drift—A gun implement, used for clearing the vent when choked In using it, a hammer must be applied to the head of the drift to drive it through the vent

Drift—In gunnery, the deviation of projectiles from their true course

Drift, Wood—This drift is required when fixing the papier maché wad in the fuze hole of filled common shell B L., it is similar to the wood drifts for common spherical shells, with the exception that the conical part is made to fit the general service fuze hole

Drifts, Rocket—Are made of wood, with brass ferrules, there are three hollow, and one solid They are used to drive the composition for signal rockets, a fifth drift, with a rounded end to protect the choke, is used to set the case in the mould

Drifts, Screw—Used for clearing the vents of Armstrong guns when clogged One per battery of field artillery allowed

Drill—The instruction given to all officers and soldiers in their respective branches It comprises the setting-up of the soldier, as well as the march and manœuvring of bodies of troops, equitation, the art of driving, and the working of guns, &c

Drill Bow—Used by different mechanics for drilling holes by hand power

Drilling Machine—A contrivance for giving rotatory motion to a drill, and by means of spur gear connected with the arm, for moving the tool to and fro, or up and down It is used for drilling holes in metals where accuracy is required, the rougher work being done by the punching machine

Drivers, Artillery—Are men attached to a battery of artillery to drive the horses They do not work the guns, but when they can be spared, are taught the gun drill The men enlisted as drivers are of shorter stature than gunners, as height and weight are not required

Drivers, Metal (Cooper's) —Made with a gun-metal head It is used for driving home the hoops on a barrel of powder, or in taking them off

Driving—This term, in the laboratory, is applied to filling fuzes, portfires, and rockets, with composition The term is also used in mining, in constructing a gallery

Driving Wheel—In machinery, the wheel which communicates the motion to the pinion, or the second wheel deriving its motion from the first, which may either be a multiplying or diminishing wheel according to the necessities of the case

Drooping—In gunnery, this term implies a wearing away of the muzzle of bronze guns after long firing Drooping occurs from the gun having much windage, and not alone from the cause hitherto given, viz, quick firing and consequent heating of the piece There

is a method now of condensing the bores of bronze ordnance

Drug Carriage—A truck carriage used for moving heavy guns in positions where the size of the platform would be inconvenient The carriage is constructed to carry guns up to 23 tons weight, and is made of African oak It is fitted with bolsters of different sizes to suit the 12, 18, and 23-ton guns The hind carriage is mounted on small stout wheels, with a gun-metal nave and hoop tire. The front trucks are wooden discs shod with a broad hoop tire The splinter bar is fitted with two pairs of frame shafts and out-riggers for swingle trees for four horses abreast. A break is fitted over each hind wheel

Drum—In machinery, the cylinder attached to the shaft over which the belting is placed, to communicate motion to the several wheels of the machine in connection with it

Drum — A musical instrument which is much used in the army for performing the beats at different times of the day in camp or garrison Drums are hollow, and covered at both ends with skins of parchment, which are braced with cords and with snares underneath They are used as a reading desk in camp when Divine Service is performed, one being placed on the top of the other

Drum-head Court Martial—Though not mentioned by name in the Mutiny Act, or Articles of War, can be held in cases of mutinous conduct necessitating instant punishment

Drummed-out—A punishment included in the award for dismissal from the service with ignominy It consists in the soldier being trumpeted or drummed-out of the barracks or quarters of the corps to which he belonged

Drying Gunpowder—In a certain stage of the manufacture of gunpowder, drying is an essential process. It takes place after the powder has been glazed Formerly, in India, gunpowder was dried by exposure to the sun, but this is now done by artificial means, in a drying room heated by steam

Drying Room—Used in gunpowder factories for drying gunpowder It is a room heated by steam pipes, and fitted with open frame-work shelves, on which small wooden trays, about 3 feet long, 1 foot 6 inches in breadth, and 2½ inches deep, are placed , the bottoms of the trays are covered with canvas or copper, and each tray holds about 12 lbs of powder The size of the room is in proportion to the out-turn of the factory per diem, say, capable of holding from 20 to 40 barrels , the powder remains in it for 24 hours, and is subjected to a heat of 130° Fahrenheit for 18 hours, or longer , the heat is communicated by steam passing through pipes arranged horizontally on the floor of the room The temperature is raised and lowered gradually, otherwise the too sudden change would be likely to destroy the texture of the grain The ceiling and roof are fitted with ventilators, through which all the moisture escapes, admitting a constant current of hot air to circulate through the room It is of the greatest importance that the vapour should be carried off, for if this is not effectually done, on the decrease of the temperature, it would condense, and form again on the powder

Dubber—An Indian term, a vessel for holding oil It is made of untanned ox or sheep skin, and is peculiar to Asiatic countries It is also termed a "*Koopah*"

Dumb-bells — Used for gymna-

sia, and are of the following weights 10 lbs., 16 lbs, 20 lbs

Dummy Friction Tube—Used for drill purposes. It consists of a steel prong, fork and lanyard, the prong is entered in the fork, which is inserted in the vent and pulled through by the same motion which fires the service friction tube Since the original pattern was approved of, it has been found that the prongs are liable to fracture at the "eye" In the present pattern the prong is made stronger, and the split of the spring is carried through its neck, instead of the latter being solid

Dundas's Guns—Guns of somewhat similar form to those of Mr Monk's, and introduced into the service, some years ago, by Colonel Dundas They are not so conical, having a greater thickness of metal in the 1st and 2nd reinforces His 68-Pr (95 cwt) is used both as a land and sea-service gun, and his 32 Pr of 58 cwt has been largely used in the navy

Dust, Powder—All gunpowder, in the process of reeling, gives off a certain amount of dust It is a great object to remove this dust from powder, as it quickly absorbs moisture from the atmosphere, and, consequently, impairs its preserving qualities The operation of dusting is effected by cylindrical reels covered with canvas, which revolve at a given rate.

Duty—In a military sense, the observation and execution of all orders which pertain to a soldier In all military service the tour of duty is invariably from the senior downward An officer on one duty cannot be ordered for any other, until he has completed the duty on which he is engaged

Garrison and brigade duties are those performed by one regiment in common with another; regimental duties by the officers of a regiment or brigade of artillery among themselves

Duty—With reference to a steam engine, is the amount of work done in relation to the quantity of fuel consumed

Dwarf Platform—The original pattern is similar in general construction to the "common traversing" platform, and guns mounted upon this nature of platform can fire through ordinary embrasures By lengthening the legs of a platform of this kind, the gun could be fired over a parapet, if required The ordinary garrison carriage is used with it, but has blocks instead of axle-trees upon which it rests, the part of the block between the cheeks being deeper, and passing between them, so as to keep the carriage in its place In front of each bracket there is a pair of check plates, in which a gun metal truck works, which comes into play when the rear of the carriage is hoisted up by the truck levers The carriage is run up by means of tackle These platforms were made to traverse on a pivot, but "raised racers" have been substituted, the platform resting on *hollow solid trucks which run upon the* racer Since the introduction of heavy rifled artillery, a change of pattern has taken place, not only in this nature of platform, but in the carriage adapted to it, which is of the ordinary "double plate pattern," both of which are made of wrought-iron Casemate carriages and platforms are similarly constructed, and the platforms of each only differ in the height they are raised from the ground, the casemate carriage and platform being designed to fire over a 2 feet 6 inches genouillère, the dwarf

carriage and platform, over a parapet 4 feet 3 inches high

Dynamics—That branch of mathematics which relates to the action of forces producing motion

E.

Ear — In ordnance nomenclature, another name for the lug or loop of a mortar shell The term was also formerly applied to the "dolphins" on light guns Ears were also attached to the larger natures of mortar shells, to assist in placing the shell in the mortar, but lewis holes are now adopted for that purpose

Earth, Moulding — Used in casting It consists of a mixture of clay, sand, and horse dung

Ebony (*Diospyros cordifolia*)—A tree common in the jungles of Southern India It is a strong, hard, close and even-grained wood, of a dark brown colour A cubic foot of unseasoned wood weighs from 85 to 90 lbs It is used in the Arsenal and Gun Carriage Agency at Bombay for drawer handles, press screws, &c

Eccentric — Not in the centre In gunnery, applied chiefly to hollow projectiles whose centre of gravity and centre of figure do not coincide Almost every spherical shot that is cast is slightly eccentric, as from the contraction of the metal on cooling, a cavity is formed in some part of the interior (rarely in the centre), which upsets the perfect homogeneity of the shot The effect of eccentricity on the flight of the shot is as follows If the centre of gravity be above and in the same vertical plane with the centre of the figure, the range of the shot will be increased, if below, the range will be decreased, if to the right, the shot will deflect to the right, and to the left, if the centre of gravity be to the left of the centre of figure The ranges caused from this eccentricity have been found to be so variable, and so little to be depended on, that no use has been made of this circumstance in the British Service indeed, such projectiles have been considered objectionable

Echelon — From the French *échelon*, a step or round of a ladder It is a formation laid down in the Field Exercise of the Army, in which the divisions of a regiment are placed in a situation resembling the steps of a ladder, a circumstance which has caused the movement to be thus designated The divisions are thus placed successively parallel to each other, but no two on the same alignment, each division having its front clear of that in advance, so that, by marching directly forward, it can form a line upon it The échelon formation is also applicable in many situations of batteries of artillery, and is particularly adapted to resist attacks in front or in flank The direct échelon of artillery is formed by the successive march of sub-divisions, divisions, or half batteries to front or rear The oblique échelon is formed by the wheel, less than the quarter circle of a battery, or any part of it, so as to be oblique to the former front, and parallel to each other It is used to gain ground to a flank while moving to the front

Eclaireurs—According to Major Burn, author of the Naval and Military Dictionary, eclaireurs are flankers, scouts of an army When the first Napoleon was Chief Consul of France, he raised a regiment of eclaireurs for the protection of Paris In the continental war of 1870, eclaireurs were employed both by the Prussians and French

Ecliptic — The "*via solis*," or sun's path, the great circle which the sun appears annually to describe among the fixed stars The ecliptic is so called, because solar and lunar eclipses can only happen when the moon is in or very near this circle

Effective — Used, in a military sense, to denote the number of men actually borne and doing duty on the strength of a company or regiment, in the field or on parade

Effects—The property of a deceased officer or soldier On the death of either, a Committee of Adjustment is formed to take charge of the property, and to adjust the affairs of the deceased, as directed by the Mutiny Act

Efflorescence—The formation of small crystals on the surfaces of bodies, in consequence of the abstraction of water from them by the atmosphere Saltpetre shows itself in this form on the surface of the ground

Elastic—Any body which, being compressed, returns to its original shape on being released The air, for instance, is an example of elasticity

Electric Fuze—*Vide* Fuze

Electric Tube—*Vide* Tube.

Electricity—The science which treats of the laws of the electric fluid, a power which causes attraction and repulsion between light bodies The following is the relative conducting power of metals —

Copper	10000
Gold	9360
Silver	7360
Zinc	2850
Platinum	1880
Iron	1580
Tin	1550
Lead	830
Mercury	345
Potassium	133

The conducting power of rods of the same metal of equal diameter is inversely as their lengths, of rods of equal lengths, it is proportional to the mass and not to the surface The conducting power is increased by lowering the temperature, and diminished, and finally destroyed, by raising the temperature Metals are infinitely better conductors than any other substances Charcoal, which has been exposed to a strong heat, is one of the best conductors, but greatly inferior in this respect to iron or platinum

Electro-Ballistic Apparatus—An apparatus invented by Major Navez, of the Belgian Artillery, which exhibits accurately the time occupied by a projectile in passing over different parts of the trajectory, also for measuring the force of gunpowder as it is actually used in every gun in the service The Electro-Ballistic Apparatus consists of a frame, across which thin copper wires are stretched horizontally in parallel lines, and of a pendulum, of which the vibration is measured The frame is placed a few paces in front of the gun or the target, according as the initial or impact velocity is required The wires, which are so close together that the projectile cannot pass between them, are connected with, and act upon the pendulum, by means of an electrical current passing through them Any one of these wires being broken by the passage of the shot, the pendulum indicates the force of its vibration, and by working out a mathematical formula, the velocity of the projectile is ascertained to the 1,000th part of a foot per second *Vide* Royal Artillery Institution Papers, from which the above is taken

Elephant — The most gigantic

of existing quadrupeds This animal is used as a beast of burden and draught in India, for carrying the camp equipage of troops, and for dragging heavy artillery The elephant is of an average height of 8 or 9 feet, some grow to 11 feet, and carry from 12 to 1,400 lbs and drag from 40 to 60 cwt Elephants are caught at the foot of the Kumaon hills in the N W Provinces of India, in Assam, and in Upper Burmah They are fed on wheaten cakes, coarse grass, and leaves Elephants breed in confinement, the period of gestation being about twenty months, and bring forth one young at a birth

Elevating Eye—To facilitate the elevation and depression of the Armstrong land service guns, an *Elevating Eye* is screwed into the under side of the breech at a suitable distance from the trunnions, for the adjustment of the gun, by means of an elevating screw, except the 110 Prs and 40 Prs, which are worked with elevating screw and quoin

Elevating Screw—In a gun carriage, the screw which elevates or depresses the gun It is attached to light guns by means of an eye and bolt Heavy guns have oscillating screws

Elevation—In gunnery, the raising of the axis of the piece sufficiently high to enable the shot to range the required distance In firing at a given object, the axis of the gun must necessarily be directed upon a point at a sufficiently vertical distance above the object to allow for the action of gravity, which causes the ball continually to descend after leaving the bore of the piece The elevation of the axis of a gun is generally regulated by means of a tangent scale, which is graduated in such a manner that the divisions on it correspond with the various ranges required from the gun

Elevation—In fortification, the projection of the face of a work on a vertical plane by horizontal rays It shows the height or depth of a work, and also its length, when the plane of projection is parallel to its face

Ellipse — In geometry, an oval figure formed of the section of a cone by a plane cutting both its sides, which plane, not being parallel to the base, meets the base of the cone when produced

Elongated Shot—The name given to cylindrical or oblong shot, which are used with rifled ordnance

Embarking, &c.—The following directions taken from the Artillery Instructions will be found applicable to nearly all the cases likely to occur, such as embarking or disembarking from a beach, from a wharf, with or without boats, in presence of an enemy, &c, &c "On the arrival of the battery at the place of embarkation, it is to draw up in as compact order as is consistent with the performance of the operations required The horses are to be taken out, the harness taken off and packed in vats, and the stores in cases When there are no vats and cases, the stores must be secured to the carriages or tied together the intrenching tools may remain with the carriages The non-commissioned officers in charge of sub-divisions will attach to their harness and stores pieces of basil, having the number of their sub-divisions written upon them The harness for each carriage should be embarked with it The gun detachments will prepare the carriages for embarkation They will take off the side arms and secure them together, take out the elevating screws, unkey the cap

squares, unlash the ammunition boxes, and coil up the lashing ropes Each carriage, when called for, is to be run forward to the boat or crane, the gun is to be unlimbered and dismounted, the ammunition boxes, shafts, wheels, &c, to be taken off, the washers and linch-pins must be carefully put away in the slow match box, and in the small box between the limber boxes Every article must be stowed away with the greatest care, and arranged so as to be got at without delay Those articles which will be the last required when disembarking, are the first to be embarked The divisions, and everything belonging to them, should be kept together as much as possible The first to be embarked are the spare carriages and forge, which are to be stowed forward, the left division next to them, and before the main hatchway, the centre abaft the hatchway, the right under the hatchway The whole of the guns are put together generally in the bottom of the hold, vents turned downwards, and a fid in them, to prevent their being choked When a battery is embarked in different vessels, every part should be complete, and a proportion of general stores be on board of each If the voyage is likely to last some days, cartouches with the ammunition must be taken out of the boxes and stowed in the magazine The ammunition must be so placed, that whatever part belongs to any particular carriage may be got at without difficulty When the cartouches are not taken out, the boxes must be stowed well aft in the hold, or between decks, and they should be carefully covered with wadmilltilts or hair cloths In embarking from a beach, it may be necessary to erect small sheers made of a couple of topgallant masts, previously prepared for the purpose In embarking from a wharf, if there are cranes, they should be made use of If boats are employed, the loads must be regulated by the state of the weather and distance of the vessels

Embarking the Horses—When the vessels can come alongside a wharf, the horses are hoisted in by means of tackle The slings, made of canvas, should be minutely inspected, to see that they are secure There must be a double guy made fast to the horse's head, one end on shore, the other on board, to keep his head steady A shoeing smith should be in each ship to receive the horses A horse requires at least four men besides the driver to sling him, one on each side, one at his breast, and one behind One end of the sling is passed under his belly, and both ends made to meet over his back, one man passes his loop through the other, it is received by the man on the other side, who hauls it through, hooking the tackle to it, both men holding up the ends of the sling The men at the breast and behind bring their ropes round, and make them fast to the grummets The driver holds the horse's head and makes fast the guys to it The horse being previously blindfolded, the word "hoist away" is given, and he is hoisted on board The slings are then taken off, and he is led to his place, the first horse being always placed forward or aft, as the ship fills, the stalls nearest the hatchway being reserved for the horses which are to be first landed The horses are to be embarked in the same order as the carriages, care being taken that the officers' and non-commissioned officers' horses are on board with the divisions to which they belong The farriers and shoeing smiths should be distributed in different ships When horses are embarked in boats, sheers, or a derrick, are necessary,

The head of the derrick must incline inwards when the horse is rising, but when he is high enough, the head of the derrick or sheers must be forced out, to bring the horses over the boat This applies to beach or wharf Sand or straw should be laid in the boats to prevent the horses slipping They should stand athwart, the head of one horse being on the starboard, and the head of the next on the port side The drivers sit on the gunwale, or stand between the horses When horses are embarked from an open beach, without any appliances, they are to be led to the boat, and the halter given to one of the men in it The horse must then be made to walk or leap into it, the gunwale of the boat being inclined towards the shore A quiet horse should first be embarked, and the others will more readily follow In embarking in presence of an enemy, the horses and carriages should first be embarked, the guns being retained to the last, to repel any attack If the position be a mile or two from the place of embarkation, it may be necessary to retain a portion of the horses

Disembarking —The disembarkation is the reverse of what has been detailed The harness is the first thing sent on shore If the water is smooth, with little surf, the disembarkation may be easily carried on upon the beach, and the horses made to leap out of the boats In disembarking in presence of an enemy, the guns should be put into boats, mounted , launches of men-of-war being best adapted for this purpose The muzzle of the gun must point forward in the boat , and as soon as the boat takes the ground, the gang-boards are put out, and the gun run ashore The limber should accompany the gun

Embrasure — An opening cut through the parapet in order to enable the artillery to fire through, and to command a certain extent of the surrounding country The space between every two of these openings, called the *merlon*, is from 15 to 18 feet in length The form of an embrasure is that of a prism, its base being a trapezium The opening of the embrasure is termed the *neck*, and is two feet wide, that towards the country, the *mouth*, which is usually made equal to half the thickness of the parapet , the other parts are termed the *sides*, the *cheeks* the *base*, and the *sole* the slope to which, is generally less than the inclination given to the superior slope of the parapet, in order that the fire from the embrasure may meet that of the musketry from the parapet at a point within a few feet from the top of the counterscarp

Emery—An opaque variety of the mineral alumina, containing a considerable proportion of iron It is ground into different degrees of fineness, and used in arsenal workshops for polishing and scraping off the outer coating of gun barrels before being re browned, also for removing rust from the interior of gun barrels with the aid of the leading-out machine

Eminence — A high or rising ground overlooking and commanding the surrounding country

Emissary—A spy, a scout In a military sense, one who during war time personates the dress, language, and character of the power or nation he is sent amongst, for the purpose of obtaining information, or for the purpose of creating disaffection in the ranks of the enemy

Encampment — The ground taken up by any force on the conclusion of its march

The order in which a Light Field Battery camp in India is pitched is as follows On the ground being selected, the guns and carriages attached to the battery are first parked, and a sentry placed over them The horses are then taken sixty yards to the rear, and picketed in parallel lines, running at right angles to the park The tents of the men are then pitched outside the lines of horses, but parallel to them, the whole breadth of stables and tents, which is the breadth of the camp, being 88 yards Forty yards in rear of the horses and tents, but at right angles to them, pitched in two lines at forty yards apart, are the officers' tents, *viz*, the subalterns' and medical officers' tents nearest the lines, then those of the 1st and 2nd captains, fifty yards further to the rear, and on the right flank, is the hospital, on the left, the bazar The guard tent is pitched on the right flank of the park, and that of the Staff Sergeant of the Battery on the right rear flank of the line of tents The whole depth of ground taken up is 300 yards, and breadth 88 yards

Enceinte—In fortification, the body of the place, which is enclosed by bastions and curtains

Encounter—Literally a combat or fight between two persons It is not unfrequently used to describe a battle or attack by large or small bodies of troops

Endless—Applied in machinery to the cord or band by which means wheels and axles are made to act on each other Sometimes the cord is placed in a groove in the circumference of the axle, and carried round a similar groove in the circumference of the wheel, this is termed an endless cord or band, by which means wheels are driven either in the same or an opposite direction The term is also applied to an endless or perpetual screw This method of transmitting the motion from wheel to wheel is presented in every department of the arts and manufactures One of the chief advantages of this method of transmitting motion by wheels and axles, is, that the bands by which the motion is conveyed may be placed at any distance from each other, and even in any position with respect to each other, and may, by a slight adjustment, receive the motion in either one direction or other

Enemy—In a military, or national sense, signifies any nation or power with whom we are at war, which includes also the allies of that power or nation

Enfield Rifle—The arm lately in use in the British Army It takes its name from the small-arm factory at Enfield It is a muzzle-loading arm, but has been converted into a breech-loader, and is now known as the Snider-Enfield there are two patterns, that of 1853 having 3 grooves, and that of 1860 with 5 grooves

The length of the barrel of the pattern musket of 1853 is 54 inches without the bayonet, having one spiral turn in 78 inches, weight with bayonet, 9 lbs, 12 oz

The short rifle musket pattern (1860) is 48¼ inches in length without the bayonet having one spiral turn in 78 inches Weight with bayonet, 10lbs 4½ oz

Some of the Native Regiments in India are now armed with the Enfield rifle

Enfilade Fire—To sweep the whole length of any work or line of troops by a fire from a battery placed perpendicularly to the prolongation of the crest of a parapet, or to a line of troops, the guns being fired with full service charges

Engagement — In a military

sense, signifies a conflict, action, or battle between two contending armies

Engine — Denotes, generally, a kind of machine in which two or more of the simple mechanical powers are combined together

Engine, Fire—A machine for throwing water to heights and distances, by means of a force-pump, and pressure from air condensed in a chamber

Engine, Fuze—For extracting a fuze when fixed in a spherical shell It consists of a frame-work of iron having a vertical and horizontal screw within it, the latter acts on a vice, which embraces the fuze, and the former on the vice to draw it up

Engineers—One of the branches of the army, to which is entrusted, in times of peace, the erection of all military buildings, and during the operations of any army in the field the construction of every description of fortified works, also the planning and direction of the attack and defence of a fortification Indeed, the duties of this branch are so multifarious, that it is scarcely possible to define them On active service, an Engineer-officer is sometimes a Sapper-officer, at another time he is found engaged in the construction of works and bridges, or he may be employed in the reconnoissance of a country, or attached to a General Officer as Engineer of the division of an army The duties of the Engineers, both at home and abroad, are fully detailed in the Aide Memoire to the Military Sciences

Before the peace of 1763, the duties of Engineers were performed by officers of the army generally, very shortly afterwards they were made into a permanent corps, and in 1783, were raised to be a royal corps In 1812, the Sappers and Miners were organised Until 1859, the non-commissioned officers and men were called *Sappers and Miners*, but this designation was then abolished and they became Royal Engineers. The *personnel* of the Engineers is composed of officers of the Royal Engineers and of the late Indian Engineers (all styled by the former designation since the amalgamation of the two services) In India, there is a corps of Sappers and Miners (Natives) at each of the Presidencies, which is commanded by officers of the Royal Engineers

Besides Military Engineers, the services of officers of the civil branch of that profession have been of late years largely employed by Her Majesty's Indian Government to supplement the establishment of this scientific branch of the Service

Enlargement of the Vent—Caused by rapid and constant firing When it becomes considerable, the vent is rebouched In old iron ordnance which had not copper vents, the gun was condemned if the hole was enlarged to two inches

Enlist—As a soldier, to receive any current coin of the realm as enlisting money, knowing it to be such, from any person employed on the Recruiting Service, hence the term "to take the shilling" Enlistment in the British army (unlike what it is in continental armies where the conscription is in force) is a voluntary engagement to serve Her Majesty at home or abroad, either for a fixed or unlimited period, in the former case for twelve years, provided the recruit is upwards of eighteen years of age at the time of enlistment *

The following system pursued in recruiting the armies of Prussia and France will not be found without

* It is now in contemplation to enlist men for six years in the active branch of the service, and six years in the reserve

interest It is taken from the military correspondent's letter to the *Pioneer*, an Indian paper —In "Prussia, the number of recruits to be raised annually is 100,000 from a population of 30,000,000, the nominal average age of joining is 19½, the practical average age (so many being put back) is 20½ They serve for three years in the standard army, four years (on furlough) in the reserve, five years in the Landwehr This brings the soldier to about thirty-two years of age He then joins the Landsturm for ten years,—a force available only for duty within the country Those youths who are exempt from the conscription form the 'Ersatz Reserve,' and are liable to military duty only in case the ordinary supply of recruits becomes exhausted

"In France, 100,000 recruits are raised out of a population of 37,000,000, but of these, only about 70,000 (including 7,000 for the Navy) are called up for service The remainder, or second portion of the contingent, form the first part of the reserve They return to their homes, and remain in the reserve nine years, during the first five of which they are the first to be called up for the augmentation of the army in time of war They receive five months' drill during the first two years The first part of the contingent serve five years in the standing army, and then four years in the second reserve, making a total of nine years, after which they are free The average age at which French conscripts join is 21

"In the Prussian army the soldier acquires a right to marry at about 23½, in France, not until 27 All the youths who are not drawn for the conscription are enrolled in the 'Garde Nationale Mobile,' in which they serve for five years, garrisoning fortresses, and, as we now see, even taking the place of the regular army, when that has capitulated or been destroyed

"The first noticeable point of difference between the two systems, is that in Prussia the recruit has to pass through *all* the classes of the army—active, reserve, Landwehr, and Landsturm—with a total liability to service in the first three classes of twelve years, in France, he has only to serve in the standing army and reserve, with a total liability to service of nine years On the other hand, those who are not drawn for the conscription in Prussia have no greater liability to military service than attaches to the 'Ersatz Reserve,' in France, such youths being enrolled in the Garde Nationale have more definite military duties to perform, and fill very much the same position as the Prussian Landwehr, only that they have not the same knowledge of their duties And in this absence of efficient *trained* second reserves, we may observe, is the conspicuous weakness of the French military system, the evil effects of which are now being fully felt in the premature exhaustion of France's military resources The proportion of the population called to military duty in France is less than in Prussia,—being 70,000 in 37,000,000, against 100,000 in 30,000,000 But this statement must undergo some modification on account of the difference in the number who annually attain the age of liability In France, the number who annually attain the age of 20 is about 320,000, in Prussia, it is about 374,000

"In Prussia, the chance of being called up to the ranks is greater than in France in time of peace, but those who escape the conscription are less liable in time of war to be called upon in the former country than in the latter. In time of war also, the strain would

be diffused over the classes of fewer years in France than in Prussia, and, in consequence, the average age of the troops would be less in the former than in the latter country"

Ensign—A commissioned officer, the lowest in rank, in a regiment of infantry A cadet, on leaving Sandhurst, receives his commission as Ensign, and is posted to an infantry regiment To the Ensigns are entrusted the honorable charge of carrying the Regimental colours

The term "ensign" is also applied to a standard, banner, or flag The ensign of the British navy is the St George's, a white ensign, with a red cross, and the union jack in the left hand upper quarter The English ensign is a red, white, or blue flag, having the union jack in the upper corner next the mast

Entanglement—*Vide* Abatis

Entrepot — An intermediate depot for the reception of stores and arms in a garrison town where there is no arsenal or magazine

Environ—To enclose in a hostile manner, to hem in, to besiege

Epaulettes — Shoulder ornaments worn by military and naval men to distinguish their rank They were done away with in the British army in 1855, but are worn in the navy, by the gentlemen-at-arms, and by Deputy Lieutenants Epaulettes are still worn in several continental armies

Epaulment—A parapet on the flank of a battery, serving to protect the guns and gunners from the fire of the enemy It is generally made of filled gabions or fascines

Eprouvette, Gun — A machine for testing the strength of gunpowder It consists of a small bronze gun, suspended by arms or rods from an axis directly above the centre of gravity To these rods graduaated arc is attached, to which an index is fitted from the point of suspension on the axis On the gun being fired, it recoils up a part of the arc of suspension, the amount of which is shown on the index This machine is now obsolete

Eprouvette, Vertical—An apparatus for testing the strength of gunpowder after it has been incorporated It consists of a small mortar into which a ball attached to a rod is placed The mortar rests in a vertical position, and is fixed in a wooden bed The rod, with the ball, weighs 28¼ lbs, and the rod is graduated to feet and inches On the charge (which consists of only half a drachm) being fired, the ball, with rod attached, is projected upwards as far as the strength of the powder will carry it, when it is prevented from descending by a small pawl which catches in a rack on the surface of the rod The height to which the shot ascends determines the strength of the powder

Equation—In mathematics, is the name given to the symbolical expression of the equality of two quantities, and generally containing at least one unknown quantity Thus, $x-3=4$ is an equation which states the equality between $x-3$ and 4, in which x is the unknown quantity A quantity is *known* when its value in numbers is given, and when this value is not given it is called an *unknown* quantity

Equation of Time—Is thus described by Milner —"It has been observed that the intervals between two successive arrivals of the sun on the meridian are not the same at all times of the year, but sometimes greater and sometimes less than 24 hours, as shown by a well-regulated clock Hence the distinction between apparent or solar time shown by the sun-dial, and true, or mean, or equinoctial time given by a clock, adjusted by an imaginary sun,

supposed to move in the plane of the equator, with an equable mean motion The difference between them, which sometimes amounts to 16¼ minutes, is called the *equation of time* "

Equator—Is an imaginary great circle passing round the globe east and west, everywhere equi-distant from the poles, dividing it into northern and southern hemispheres The equator of the heavens, or the equinoctial, is the plane of the terrestrial equator extended to the concave surface of the heavens, and called the equinoctial, because when the sun appears in it, the days and nights are equal all over the world

Equerry—In the British Court, a subordinate officer under the Master of the Horse There is a chief equerry, also four equerries in ordinary, and an equerry of the Crown stables

Equilibrium — A perfect balance thus, when the weight in one scale, and the substance to be weighed in the other, balance each other, they are said to be *in equilibrio* Or it may be defined as the state of rest produced by two or more mutually counteracting forces

Equipage—In a military sense, implies everything needful for a regiment or army to be supplied with for a march or operations in the field

Equipage, Camp—This term is applicable to the tents, kitchen furniture, and other articles belonging to troops under canvas In India, tents are usually under charge of the Ordnance Department, and are supplied to regiments and depôts on indents sanctioned by the Inspector-General of Ordnance The supply of new tents is furnished by contract, either through the Commissariat, or direct to the Ordnance Department, they are passed into the service after being inspected and approved of by the Ordnance Officer under whose charge they are finally to be stored.

Equipment—In the army, signifies the munitions of war, *matériel*, and other stores required for troops of all arms, which are supplied by certain departments charged with their administration In the artillery branch the term "equipment" includes the ordnance and carriages, the supply of ammunition and stores, as well as the men attached to the several Batteries — Horse, Foot, and Siege — composing the artillery of the service In India, the new bronze muzzle-loading rifled gun is to form the equipment of the Horse Artillery, Field Batteries receiving a heavier gun The provision, however, of bronze guns, notwithstanding the orders on the subject, is in abeyance, pending further trials with this nature of metal, both in England and in India Should bronze ordnance prove less enduring than the trial guns of this metal tested by the Indian Committee, steel or iron will probably be substituted The equipment of a siege train depends much on the class and position of the fortress to be attacked, and facility of transport afforded by the country in which the operations are to be carried on It was laid down some few years ago as a basis for siege equipments, that 30 pieces should be the unit in calculating for siege trains, consisting of ten 8-in guns of 52 cwt, ten 24-Prs of 50 cwt, five 8-in mortars, and five 5½-in mortars, which could be multiplied in any number necessary for the attack of larger or more considerable fortresses

Since the first edition of this Dictionary was published, a change in the proportion of guns, as well as in the guns themselves, has been made in the equipment of a siege train, consequent on the introduction of rifled guns, and the armament, now, for siege trains, and guns of position, is the 7-in,

64-Pr, and 40-Pr breech-loading guns, and the muzzle-loading 64-Pr shunt gun

Equitation—The art of riding Military equitation, the principles of which are the same for all classes of cavalry, consists in the skilful and ready application of the aids with which the rider guides and controls his horse in all his paces, and in a settled balance of the body, which enables him to preserve a firm seat in every variety of movement The aids in horsemanship are the motions and proper application of the bridle hand and legs, to direct and determine the turnings and paces of the horse Military equitation may be divided into three parts—

1*st*—The complete instruction of the recruit upon a trained horse, from the earliest to the last lessons

2*nd*—The training of the horse by skilful and experienced men

3*rd*—The practice of the recruit and remount horse at close files in the elementary parts of Field Exercise, to prepare them for instruction in the troop or squadron This science is indispensably requisite for the military horseman, in order that, being able to govern his horse by the aid of his legs and bridle hand, he may have the right hand at full liberty for the use of his weapon, and be capable on all occasions, whether acting singly or in squadron, of performing his various duties with care With this view, both men and horses should be constantly practised in the exercise of such lessons as will enable them either to move in a compact body, or to act singly or independently

Erosion — The act of eating away As applied to guns, it is the guttering or scoring observed at the seat of the shot after much firing, and is caused from the action of the inflamed gunpowder upon the metal as it passes between the upper surface of the shot and the gun It will probably be found that the sulphur is the eroding part of the gunpowder, from its affinity for iron in its heated state, forming sulphide of iron

Escalade—An attack on a fortified place or work, by means of escalading ladders

Escarp or Scarp—In fortification, the side of the ditch next to the place, which, in a permanent work, is faced with masonry The scarp is less steep than the counterscarp, because it has to sustain the weight of the parapet It is usual to give the slope of the scarp a base equal to two-thirds of the base of the natural slope of a mound of fresh earth, whose altitude is equal to the depth of the ditch Vauban generally gave his revetments a slope of one-fifth of the total height of the wall

Escort—A guard of troops attending an officer or person of distinction when travelling It is also a guard placed over prisoners on a march, or military stores in transit

Esplanade—A clear space of ground separating the citadel of a fortress from the town

Esprit-de-Corps — A term well known in the army It literally means *brotherhood*, but in military life it means more than this It is the feeling of attachment a soldier has for his regiment, even to the point of thinking it the best in the army It fosters good-will and fellowship among officers and soldiers It produces an emulous thirst after military glory In fact, true *esprit-de-corps* creates such a feeling of enthusiasm and love for all that is honourable and noble, that an officer or soldier will be careful in his conduct to do nothing which would bring dishonour or reproach on his regiment

Ess—A couple or spare link in the form of an S, with holes to receive a leather thong. Esses are used to unite broken chains, traces, &c Chains can also be lengthened or shortened by their means

Establishment — The extent, "matériel," and "personnel" allowed to a force in peace and war times, which, in the former case, is regulated according to the exigencies of the Service, and which, being much greater during war than peace, has given rise to the distinction of a War and Peace Establishment

Estimate—A computation of the probable expense of any project framed on recognised data, derived from previous experience (*Vide* Accounts)

Euphorbia Tirucalli — This plant is much used in making hedges in India It is an evergreen The wood is said to make very fair charcoal for gunpowder purposes, but the experience derived at the Ishapore Gunpowder Works in Bengal is, that it is valueless for this purpose In Bengali it is called *Lunka sij*, and in Hindustani, *Sendh*

Evacuate—To withdraw from a town or fortress, in consequence either of a treaty or a capitulation, or of superior orders

Evidence—As given before a Court Martial, is a declaration on oath by the witness of any circumstance he is personally acquainted with, having reference to the matter brought before the Court

As laid down in Pipon's Manual of Law, the examination of the witness may be conducted either by his being told by the President or the Judge Advocate, as the case may be, to state what he knows, by means of question and answer, or by both Every question, whether put by the prosecutor, the Court, or the prisoner, must be in writing, and must first be handed to the President if approved by him, it is entered in the proceedings If not approved by the President, and the party insists on putting the question, the Court being cleared, proceeds to determine by vote (the President, in case of equality, having a second or casting vote) whether it shall be put or rejected

Evolutions, Military—The movement by which troops change their position either for attack or defence Those evolutions are best which can be executed with the greatest celerity compatible with regularity, and which are founded upon strict mathematical principles In these days of arms of precision, it is necessary that change of movement should be as rapid as possible

Examination of Ordnance—This is performed in the first place after a gun has been made, in the second, periodically, when the gun is in use, and lastly, in the case of smooth-bored iron ordnance, after each day's firing In firing heavy rifled M L guns, it is ordered that the examination of the 9-inch gun shall take place after firing any number of rounds according to circumstances, but with the 10-inch and 12-inch guns, they are to be examined, the former after 250 rounds, the latter after 100 rounds

Exchanges—In the army, occur between officers on full pay, whether of cavalry or infantry, or from cavalry to infantry No exchange can take place without the recommendation of the commanding officer, who has at the same time to certify that the exchange recommended does not originate in any regimental proceeding of any kind, or in any cause affecting the honour and character of the officers, with certain

other stipulations. Exchanges can be made to half pay, either with or without the difference, or from cavalry to infantry. The application under these circumstances is to be general and unconditional, and the officer on full pay will not be allowed to point out his successor.

Execution, Military.—Implies in these days the punishment of a soldier by hanging or shooting. Formerly it comprised also flogging and running the gauntlet, &c.

Exercise.—In a military sense, manœuvring bodies of men together. The drill given to a mounted battery of artillery is termed *exercise*.

Exercise, Laboratory.—The instruction imparted in the manufacture of combustible and warlike stores.

Exercise, Repository.—The mechanical manœuvres with heavy guns, where tackles, levers, capstans, &c., have to be used.

Expansion.—Is the general effect of heat in causing enlargement or expansion in solids, liquids, and gases. The effect of expansion is seen on heating cannon shot. It is found that shot, on being slowly cooled, become permanently enlarged.

Expansive Steam.—The method of applying and economising steam power in engines. It is thus explained in Weale's Dictionary of Terms of Art:—"If we allow steam to flow into the cylinder of a steam engine, until the piston be depressed to one-half of the stroke, and then prevent the admission of any further quantity, the piston will, if the engine be properly weighted, continue its motion to the bottom. The pressure of the steam, so long as the supply is continued from the boiler, will be equal, it is presumed, to ten pounds upon the inch. With this force, it will act upon the piston until it completes one-half of the stroke: the further supply of steam will then be excluded, and that which is in the cylinder will expand as the piston descends, so that when the stroke is complete, it will occupy the entire capacity. The pressure of the steam will then be half of its former amount, or five pounds upon the inch. During the descent of the piston, the pressure of the steam does not suddenly decrease from ten pounds to five, but it gradually declines through the successive intervals, until at the final point it yields that force. It is by this gradual expansion and diminution of the pressure that the superior action is produced."

Expedition.—In a military sense, signifies the organisation of a body of troops for any sudden dash upon the enemy, bands of marauders, or freebooters. One of the principles of many small expeditions is surprise, which, if well carried out, will ensure success. To the soldier, no part of his duty is so exciting and interesting as an expedition, for it implies risk, hazard, and danger, which to the enthusiastic soldier is the nature of warfare he delights in.

Expense Magazines.—Are small gunpowder magazines. In a fortress there ought to be an expense magazine to each bastion and battery, though this is not always the case. They generally contain only made-up ammunition,—that is, cartridges for the ordnance in the bastion or battery, at the rate of so many rounds per gun, to which are to be added the tubes and port-fires; sometimes the side-arms and case shot, &c., are kept there, and are usually under the care of the artillery officer in charge of the district. Expense magazines are often made under the earthen ramparts of fortifications,

with a cut or passage made into them in the interior slopes, they ought not, however, to be made until a siege be apprehended, for, as they are only temporary, and constructed of wood-work, they are liable to become damp, and decay. This description of expense magazine might be made of masonry, and thus become permanent.

Explosion—The sudden expansion of an elastic fluid with force and a loud report, as is heard in the blowing up of a mine or the bursting of a shell.

Exterior Slope—In fortification, is the slope given to the outside of the parapet. It is found by experience that earth of common tenacity will naturally acquire a slope of 45°, even when battered by cannon. This inclination is therefore given to the exterior slope in the first instance, in order that the fire of the enemy's artillery may not subsequently alter its shape.

Extractor—An instrument used in extracting a projectile from a M. L. rifled gun. That introduced into the Service for every calibre of Woolwich projectile, is constructed so as to act independently of the grooves of the gun. For a description of the extractor, *vide* Treatise on Ammunition, Part II, by Captain C. O. Browne, R.A.

Eye Pins—In artillery, are iron pins on either side of the trunnion beds of a gun carriage on which the cap-squares fit, and to which they are fastened by a chain and key.

F.

Face—In drill, the order given to soldiers, individually or in a body, to turn or face to the quarter directed. In fortification, the name given to certain portions of a fortified work, such as the faces of a bastion or ravelin.

Face of a Gun—Is the terminating plane, perpendicular to the axis of the bore.

Facing Implements—Used for facing or renewing the vent and breech pieces of an Armstrong gun.

Facings—The movement by which soldiers, when halted, turn to the right, left, right-about, left-about, &c. The term also implies the colour of the cuffs and collar of the clothing of a regiment. Regiments are distinguished by the colour of their facings.

Fall—In artillery *materiel*, the name given to any rope which is passed through blocks, so as to form part of a tackle. The rope attached to a gyn, which passes over a double and triple block, the end of it passing round the windlass, is termed a "fall." The fall for this purpose is generally made of $5\frac{1}{2}$ or 8-inch Europe rope, depending on the weight to be lifted.

Fall—In military language, a town or fortress is said to fall when it is compelled to surrender to a besieging army.

False Attack—A feigned assault made for the purpose of diverting the enemy from the real point of attack.

Fanfare—A particular military sound made on the trumpet. A flourish of trumpets.

Farcy—A contagious disease among horses, caused often from want of ventilation, impure air, overcrowding, &c. It is the same disease as glanders, only in a modified form. (*Vide* Glanders.)

Farriers—Artificers attached to cavalry regiments or to the mounted branches of the artillery for the purpose of superintending the shoeing of the horses. The name "farrier" is derived from the Latin word *ferrum*, iron, which is the material of which horse-

shoes are made, indeed, the old writers call it "ferrier" or "ferrer" The farriers have general superintendence over the horses as regards their health, in subordination to the veterinary surgeon They are also responsible for the conduct and work of the smiths and others in the workshop

Fascine — Twigs or brushwood fastened together, forming a cylindrical fagot, 8 feet long, and 9 inches in diameter Fascines are sometimes cut in two or three parts,—in the former case for covering galleries, in the latter, for crowning gabions in trenches

Fathom—A linear measure, equal to 6 feet, and founded on the distance between the finger points when the arms and hands are extended horizontally Rope is sold by the fathom A coil of rope generally measures 120 fathoms

Fatigue—The term given to a party of soldiers told off for any other duty than a dress parade necessitates

Fausse-Braye — In fortification, is a kind of second *enceinte*, but since the introduction of the covered way, this work is quite inapplicable to a front furnished with, and covered by, a glacis

Felloes—Segments of wood dowelled together, and into which the spokes of a wheel are fitted A felloe consists of the back or streak side, the bosom or spoke side, and the chin, where the dowel pin is introduced Each light gun carriage wheel has six felloes

Female Screw—Is formed by a spiral cavity cut on the concave surface of a cylinder, corresponding exactly to the thread of the male screw, which is to turn in it

Fencibles—Regiments which are raised for limited service, and for a limited time The officers have the same rank as officers of militia according to the dates of their respective commissions.

Fencing—Forms one of the exercises engaged in in the assault of arms It is the art of attacking an enemy, as well as of defending one's self, and is a very salutary exercise for both officers and soldiers, rendering them expert in the use of the sword

Fetlock Joint—The joint immediately above the pastern of a horse's foot

Fever — In veterinary pactice, a disease characterized by increased heat, quick pulse, and thirst In horses, it is caused by cold or chill, high feeding, irritation, or pain The symptoms are, lassitude, shivering, quick pulse, and breathing after feed The cure is bleeding, and keeping open the bowels by clysters and laxative medicine The animal's body and extremities should be kept warm by clothing and hard rubbing, the diet, green meat or bran mashes, chilled water, and the horse should be kept as quiet as possible (*Vide* Small's Veterinary Tablet)

Fid—A block of wood used in heavy gun exercise, for slinging the gun, and for mounting and dismounting purposes

Field—In a military sense, is the ground on which an army stands in the day of battle The term is expressive of troops when entering on a campaign, and as long as they are engaged against an enemy Hence they are said to keep the field

Field Artillery — Consists of horse artillery and field batteries, which, from their lightness and mobility, are easy of draught The horse artillery consists of 9-Pr, and the field batteries of 12-Pr rifled guns (Armstrong) There are also some field batteries still in India composed of 9-Pr smooth-

bored guns A new bronze M L gun, termed the Indian gun, has lately been sanctioned for all batteries in India; but, from the lightness of the gun, it is stated that it will only be supplied to the horse artillery Since this gun was sanctioned, signs of erosion have appeared in those which have been issued in England, after firing a few hundred rounds, so that possibly steel or iron guns will yet be substituted for bronze

Field Fortification — Works of a temporary nature thrown up for the preservation of a post, camp, &c

Field Marshal — The highest military title an officer can enjoy, and which is in most cases bestowed on the oldest and most meritorious officers in the army

Fife—A wind instrument, generally used in military music as an accompaniment to the drum James, in his Military Dictionary, states that it is an instrument of high antiquity, and that it was used in the English army till the time of James I After that time it was in disuse until the year 1747, when it was introduced into the Foot Guards by the Duke of Cumberland at the siege of Maestricht

Fight — A battle or engagement between contending forces To "fight it out," is to continue the contest until one side or the other gets the better The French express it as *se battre a outrance*

Figure of Merit—In a military sense, denotes the efficiency of a squad, company, or battalion, in shooting It is measured by adding together—

1 The average points obtained in what is termed the 1st period, 20 rounds a man, up to 300 rounds, which is carried to two places of decimals, say	Points	41 23
2 The average points obtained in volley firing, 10 rounds, kneeling, at 400 yards, say	Points	20 67
3 Percentage of 1st class shots (at the conclusion of the annual Musketry course), *minus* the percentage of 3rd class, shown thus, $\frac{64\ 72}{7\ 89}$ =		56 83

When the latter exceed the former, the word *nil* is substituted

Total figure of merit of the Squad, Company, or Battalion 118 73

File—In a regiment or squad, two men,—a front-rank man and his rear-rank man

File—Is a strap or bar of steel, the surface of which is cut into fine points or teeth, which act by a species of cutting closely allied to abrasion When the file is rubbed over the material to be operated upon, it cuts or abrades little shavings or shreds, which, from their minuteness, are called file dust, and in so doing, the file produces minute and irregular furrows of nearly equal depth, leaving the surface that has been filed more or less smooth, according to the size of the teeth of the file, and more or less accurately shaped, according to the degree of skill used in the manipulation of the instrument The files employed in the mechanical arts are almost endless in variety, and the use of the principal ones only are given in this work (*Vide* Haltzepffel's Turning and Mechanical Manipulation)

Files, Flat, or Hand-files—Are in length, section, and teeth, like the "taper files," but they are nearly parallel in width, and somewhat less taper in thickness these are used for flat surfaces

Files, Half Round — Vary from about 2 to 18 inches in length, and are almost always taper The convex side is essential for a variety of hollowed works, the flat side is used for general purposes

Files, Hand-saw—Vary in length from 3 to 6 inches They are triangular in shape, and are used for sharpening the teeth of saws

Files, Round—Range from 2 to 18 inches in length, they are, in general, taper, and much used for enlarging round holes

Files, Saw Tenon—Are termed back saws, for cutting the shoulders or the transverse cuts of the tenon

Files, Square — Used for small apertures, and those works to which the ordinary flat files are, from their greater size, less applicable The square files measure in general from 2 to 18 inches, and are mostly taper, they have occasionally one side "safe," or uncut

Files, Taper—Are made of various lengths from 4 to 24 inches, and are rectangular in section They are considerably rounded on their edges, and a little also in their thickness, their greatest section being towards the middle of their length, or a little nearer to the handle, whence these files are technically known to be "bellied" They are cut both on their faces and edges with teeth of four varieties,—rough, bastard, second cut, and smooth cut teeth Taper flat files are in general use amongst smiths and mechanics for a great variety of ordnance works

Files, Triangular—From 2 to 16 inches long They are used for internal angles more acute than the rectangle, and also for clearing out square corners

Fillets—Bands or mouldings on smooth-bore guns, such as the vent field and muzzle fillets

Filtration—In chemistry, the separation of solids from liquids The apparatus in chemistry required for this purpose are funnels and funnel stands, lute jars or beakers, stirring rods, glass plates, a wash bottle, and filtering paper The best paper for filtering purposes is that imported from Sweden

Finding—Is that part of the proceedings of a Court Martial, when, the evidence having been concluded, the Court proceeds to deliberate with closed doors on the guilt or innocence of the prisoner The President takes the votes of the Court, beginning with the junior member a majority of votes decides whether the prisoner is "guilty" or "not guilty" In a case of equal votes, the President has not a casting vote, and the prisoner is acquitted

Fire—In a military sense, to discharge a piece of ordnance or any firearm To ignite a mine or train of powder

Fire-bricks — Used for lining furnaces, and for all kinds of brick-work exposed to intense heat which would melt common bricks. They are made from a natural compound of silica and alumina, which, when free from lime and other fluxes, is infusible under the greatest heat to which it can be subjected Oxide of iron, however, which is present in most clays, renders the clay fusible when the silica and alumina are nearly in equal proportions, and those fire-clays are the best in which the silica is greatly in excess over the alumina Fire-bricks are imported into India from England

Fire-hooks — For pulling the thatch off barracks and other buildings so covered, in case of fire They are made in India of *sal* or any other suit-

able wood, when bamboo is not procurable

Firelock—A term applied to a musket with a flint lock, so called from producing fire of itself, by the action of flint and steel Firelocks are said to have been first used in 1690, when matchlocks were universally discarded The Dutch appear to have been the inventors of this arm

Fire-master — A post formerly held in the Royal Arsenal, Woolwich, by an officer of artillery, whose duty it was to attend to all laboratory work The designation of fire-master is still known in the ordnance branch of the service, as to the fire-master is entrusted the inspection of ordnance stores at foreign stations

Fire-worker — Formerly an assistant to the fire-master In the early organisation of the British Artillery, this title was given to the junior subaltern grade, the designation of the officer being Lieutenant Fireworker

Fireworks — A pyrotechnical display, and used chiefly on days of rejoicing and the like They are made up in the laboratory of certain combustible stores, in which the ingredients of gunpowder form the larger part The variety of stars and colours observed in fireworks are formed from chemical ingredients

Firmness—Represents steadiness, constancy, resolution Firmness of character and firmness of purpose are such essential qualities in the commander of a regiment or army, that the want of it is the sure forerunner of disorganisation and disaster Without firmness of purpose in dealing with soldiers, no regiment or body of men can be commanded

Fit for Service—From this expression is understood, being in a good state of health and capable of bearing fatigue The complaints which disable a soldier from being "fit for service," are laid down by the medical department, and are such as to incapacitate a man from doing his duty

Fixed Ammunition — When the cartridge is attached to the projectile, the two together are termed "fixed ammunition" During the last, and even in the beginning of the present, century, this nature of ammunition was used for all calibres, but latterly it has been restricted to the 3-Pr for mountain service

Flag—That used on shore, in forts and other positions, is the Union Jack, which flies from every British fortress, and is allowed to certain authorities *Vide* Flag Staff The Viceroy of India has a Union Jack with a lion in the centre, surmounted by a crown All honors, as to the Royal Standard, are directed by Her Majesty to be paid to this flag The measurement of flags is as follows —

For Garrison	24 × 18 feet	
" G G or C in C	18 × 12	"
" Divisional Officer	12 × 18	"

The latter when in camp is provided with a flag 8 × 5½

When embarked in boats, General officers fly a union flag, 6ft × 3 ft, having in the centre the royal initials surrounded by a garland on a blue shield, and surmounted by a crown

Flag of Truce—A flag (generally a white handkerchief) attached to a staff and carried by an officer from the enemy, who wishes to hold communication with the General or other Commanding Officer of the opposing force Besides the flag, the approach is signified also by the sound of a trumpet

Flagging Iron — A cooper's tool having two prongs It is used for opening the joints of the head of

a barrel to insert a *flag* in a joint; the two prongs of the flagging iron being used on different staves, and a side pressure being exerted on the arm

Flag-staff — A mast or pole on which a flag or standard is hung One is allowed to each fort or fortress, to the Governor-General, Commander-in-Chief, Governors of Provinces, Officers commanding divisions or districts of the army They vary in length, the flag-staff of a fortress being from 100 to 150 feet, a general officer's 60 feet, a Brigadier's, 30 to 40 feet

Flam — A beat or tap upon the drum which was formerly used in the British army, when regiments were going through their drill or exercise, every formation being done by tap or beat upon the drum It was likewise used whilst firing

Flander's Wagon—A wagon suited to the transport of all light stores

Flange or Flanch—The projecting rim of metal on the circumference of a wheel or cylinder, such as is observed on railway wheels Also the flat rim of metal round the mouth of gun caps

Flank — The extreme right or left of a body of troops or a military position

Flank, Pivot—When a regiment is drawn up in column right in front, that is, when the company that stood on the right when in line is in front, the left will be the pivot flank of each company When the column is left in front, the right will be the pivot flank of each company

Flank, Reverse—The extremity of the division farthest from the pivot flank

Flanks, Retired — In fortification, are those made behind the line which joins the extremity of the face and the curtain towards the capital of the bastion

Flaw—In casting or forging, any crack or opening which may be observed In forging it occurs from bad welding

Fleche — In fortification, the most simple species of field works, and, being quickly and easily constructed, *it is frequently used in the field* It usually consists of two faces forming a salient angle towards some object, from whence it cannot be approached on the prolongation of its capital One simple rule for the construction of a flèche is to select a spot for the salient, and to throw up a breastwork on either side forming an angle of not less than 60 degrees, and allowing a distance of a yard to each file

Fleeting—This term is applied to shifting or overhauling a tackle

Flowers of Sulphur — The pure sulphur obtained by sublimation, which appears in the neck of the retort in the form of a very fine powder, known as "flowers of sulphur"

Fluorine—An elementary principle contained in fluor spar, which is so called from its acting as a flux in the working of certain minerals

Fly Wheel — A wheel, with a heavy rim, fixed upon the crank shaft of a land engine for the purpose of equalising the motion, by the centrifugal force absorbing the surplus force at one part of the action, to distribute again when the action is deficient

Flying Bridge — Consists of one or more barges moored by a long cable to a point in the centre of the stream When the barge is properly steered in a current sufficiently strong it is swept by it from one bank to the other

Flying Camp—A force of three, four, or five thousand troops, principally of cavalry, kept constantly in the

field to cover its own garrisons, and annoy the enemy.

Flying Sap—In fortification, is a sap formed by placing and filling several gabions at the same time, which may be done at times when the defence is slack. The term is also applied to the usual formation of the second parallel in the attack.

Followers, Camp — The men who follow a camp, such as officers' servants, sutlers, &c. Camp followers are subject to the Articles of War, as well as soldiers.

Foot—A linear measure of twelve inches.

Foot-board — In an artillery carriage, the planking which covers the frame of a limber or ammunition carriage in front and at the foot of the ammunition boxes.

Forage or Fodder—As understood in the army, is the food given to horses and other animals in the service. It is of two kinds, green and dry, the former consisting of green grass, tares, vetches, &c., the latter of corn, oats, barley, and hay. In India, the daily food given to horses consists of gram and grass. Generally 4 seers per horse is given of the former during the hot season, and 5 seers throughout the cold weather, and when the horses are on the march. Grass is provided by grass-cutters, of whom there is one to every horse, or one to every two; but in the latter case, the grass-cutter has to provide a pony, and bring in grass for two horses, for which he receives double wages. The grass is cut from the surrounding country, the men going sometimes 15 or 20 miles to gather it. Surplus grass is very often stacked by officers, by which means a ready supply of hay is at hand when grass is scarce, which occurs in some districts in the north-west of India, during the hot and dry season. On the march, should it be difficult to obtain grass, a requisition is to be made on the civil authorities to collect it at any named place.

Force — Any cause which produces, or tends to produce, a change in the state of rest or motion of a particle is called *force*. The term is also applied to an armed body.

Ford—The shallow part of a river where troops may cross without injuring their arms. The depth of fords for cavalry should not be more than 4 feet 4 inches, and for infantry 3 feet 3 inches; should the stream, however, be very rapid, depths much less than these could not be considered fordable, particularly if the bottom is uneven. Carriages with wheels, 5 feet in diameter, may cross a ford 4 feet deep; but if it is necessary to keep their contents dry, the depth should not be more than 3 feet. If the force of the current is great or rapid, it may be broken by the cavalry crossing a little above the ford; but if the bottom is sandy, the cavalry should cross after the infantry and artillery, as the passage of the former deepens a ford sometimes very materially. Care must be taken that the horses are not allowed to trot in fording, nor to halt while crossing.

Forge — To beat out, or form by the hammer, metal which has been heated in the furnace. Steam hammers are very generally used for this purpose in all large smithy establishments.

Forge—A furnace or place where iron is heated and beaten into shape. Forges are either stationary or portable. The former comprise all those used in workshops, the latter with batteries. In large establishments, the forges are always blown by steam.

Forge Wagon—One is attached to each horse artillery and light field battery, it is composed of a limber and carriage, the former having one long box instead of two short ones in which the tools are kept, as in an ammunition wagon limber

Forlorn Hope — In military parlance, signifies men detached from several regiments, or otherwise appointed, to make the first attack in the day of battle or at a siege to storm the counterscarp, mount the breach, &c In the French army, the forlorn hope is called *enfans perdus*, from the great danger and imminent risk to which it is unavoidably exposed

Form—In drill, to assume or produce any shape or figure, extent or depth of line or column, by means of prescribed rules in military movements or dispositions

Formers, Cartridge—Wooden shapes for cutting out the form and size of cannon cartridge bags, their size and shape depend on the nature of cartridge to be made

Formers, Port-fire — Are made of wood, of a diameter slightly larger than the port-fire setting drift They are used for making port-fire cases

Formers, Signal Rocket—For forming the cases of signal rockets They have a movable piece from two to three diameters in length, which is termed the nipple, the smaller end of which fits into a hole made in the former, and, when slightly drawn out, keeps the neck of the case open while the choke is being formed and secured

Fort — In fortification, a work built for the protection of any particular spot of importance, and erected either as a permanent or field work In the latter case, star and bastion forts are the most common

Fortification — The art of strengthening a town or other place, or of putting it in such a posture of defence that every one of its parts defends and is defended by some other parts, by means of ramparts, parapets, ditches, and outworks, to the end that a small number of men within may be able to defend themselves for a considerable time against the assaults of a numerous army without

Fortification may be divided into ancient and modern, offensive and defensive, regular and irregular, natural and artificial

Fortify—To strengthen any place by artificial or other means, so as to render it strong enough to bid defiance to any meditated attack or insult

Fortress—In fortification, the name given to a permanent work or fortified city France affords examples of some first class fortresses, such as, Strasbourg, Metz, and others, including Paris, which capitulated to the Prussians during the war of 1870-71

Fougass — A small mine from six to twelve feet under ground, charged either with powder or loaded shells, and sometimes loaded with stones instead of being tamped in the ordinary way

Foundry, Gun—A building in which metals (bronze or iron) are cast into moulds or shapes for gun purposes The subsequent operations of boring, rifling, and finishing off the gun, are carried out in rooms specially adapted for the work to be performed in each There is only one Foundry in India, *viz*, at Cossipore, near Calcutta, where bronze ordnance alone are cast The Foundry establishment consists of a Superintendent, usually an artillery officer, a mechanical engineer, with a few European mechanics, and a certain number of native artificers

Fractions—Are known as either vulgar or decimal Vulgar fractions denote a part or parts of a unit They are expressed by two numbers placed one above the other with a line drawn between them; the lower number is called the "denominator," and shows into how many equal parts the unit is divided, the upper is called the "numerator," and shows how many of such parts are taken to form the fraction Decimal fractions differ from vulgar fractions in having always the same denominator, and following the same laws as whole numbers, like which they can be treated in every respect They are represented like ordinary figures, and distinguished by a dot on the left hand side, thus, 456 expressed fractionally, represents 4-tenths, *plus* 5-hundredths, *plus* 6-thousandths, or 456 thousandths

Fraise—In fortification, a palisade inclining to the horizon, placed round a work near the berm for defence

Framing—In artillery this term is applied to the wood-work of a limber or ammunition wagon on which the ammunition boxes sit The frame in the latter case consists of side and bottom cross-pieces, which compose the wagon body, in the former, of one centre and two side framing pieces

Franc-tireurs—Derived from two French words—*franc*, free, and *tireur*, a shooter

A body of these men were raised by France during the Franco-Prussian war in 1870, for the purpose of harassing the rear of the Prussian army, cutting off their supplies, and doing them the utmost possible injury They were formed into regiments, but detached, guerilla-like, in small bands all over the country

Frapping—In artillery, drawing together the several turns of a rope or tackle, which have been already strained to the utmost The end of the rope or tackle may be used for this purpose

Fraser Gun — This gun takes its name from Mr Fraser of the Royal Gun Factories, Woolwich, and is a modification of Sir W Armstrong's original gun, which was built up of several short single wrought-iron coils shrunk together and a forged breech piece In Sir W Armstrong's system, the number of coils which had to be shrunk on entailed time, expense, and labor, as each coil, as it was shrunk on, necessitated the mass being moved from the shrinking pit to the turning lathe, and turned down for the next and succeeding coils to the smoothness of glass

In Mr Fraser's construction, which differs from the Armstrong principally in building up a gun of a few long double or triple coils, only two shrinkings are necessary, and as described by Captain Stoney, R A, in his paper "On the Construction of our Heavy Guns" (from which the above information has been derived), "where fifty tons were moved in the former case, only seven are moved in the latter"

Again, Captain Stoney says, in remarking also on there being less waste of material —"From these circumstances, combined with the employment of a cheaper iron, a 'Fraser' gun can be made at two-thirds of the cost of a gun of the same nature as originally manufactured"

The reader is referred to Captain Stoney's interesting paper above alluded to, which is published in the proceedings of the R. A Institution, No 11, vol 67 of 1870

French Rifled Gun — Is a bronze muzzle-loading piece, having 6 grooves, the inclination being one turn

in 59 inches, the calibre of the field piece is 3·41 inches, the weight of the gun 6·5 cwt., and its charge 1·21 lb. The projectile is cylindro-conoidal in form, but with a flattened point, and it has two sets of projections or buttons of zinc metal, to prevent injury to the bore, which fit into the grooves of the bore, one set being round the shoulder, and the other round the part near the base, which centres the projectile. The initial velocity of the shot is 1,056 feet per second.

Friction.—The resistance which bodies experience when rubbing or sliding on each other, or the resistance in machines caused by the contact of different moving parts. By the aid of lubricants, friction may be reduced to a certain extent, but can never be thoroughly got rid of. Friction manifests itself in many different ways according to the kind of motion one surface has upon another, and is proportional to the pressure, that is, everything remaining the same, the friction increases as the pressure increases. In draught, there are two kinds of friction opposed to the movement of a carriage.

1st.—That of the arms of the axle-tree in the naves.

2nd.—That of the felloes upon the ground.

The more the causes producing these two kinds of friction are attenuated, the easier will be the movement of the carriage. With reference to the first kind of friction, take two wheels of different heights, having axle-tree arms of the same diameter, the friction will be in the inverse ratio of the height, that is to say, wheels of two feet in diameter experience double the friction of wheels four feet in diameter, equal in all other respects, consequently the higher the wheels are, the less friction will be in their naves. In two wheels of the same height having axle-tree arms of different diameters, the friction in the naves is in direct ratio of the diameter of the arms, that is to say, an arm of four inches diameter, will experience double the friction of an arm two feet in diameter. Therefore the thinner the axle-tree arms are, the less will be the friction in the naves. In two wheels of different heights, having axle-tree arms of different diameters, the friction will be in inverse ratio of the quotients of the heights of the wheels divided by the diameters, for instance, should one wheel be 50 inches in height, diameter of axle-arm 5 inches, and the other 60 inches in height and 2 inches in diameter, the friction experienced by the former will be to that of the latter as $\frac{60}{2}$ to $\frac{50}{5}$, or as 3 to 1. Therefore to facilitate "draught," wheels must be made as high, and axle-tree arms as thin, as possible. The friction in naves depends principally upon two things—

1st.—The weight bearing upon the axle-tree.

2nd.—The kind and quality of the materials of which the axle-tree and interior of the naves are formed.

The second kind of friction presents two cases, *viz.*, 1st.—When the ground upon which the carriage moves is *horizontal*, but sandy, muddy, or rugged. 2nd.—When ground of the same nature as in the former case makes, likewise, an inclined plane.

Friction Plate.—A plate of iron placed on the trail beam of gun carriages, at that point where the wheel locks with the carriage. The plate is placed in that position to prevent injury to the trail.

Friction Tubes.—Used in discharging guns in lieu of priming powder. They are made of sheet copper, 16 oz. to the square foot. The

tubes are 3 inches long, $\frac{2}{10}$ths of an inch in diameter, and filled with closely tamped mealed powder, having a vent hole down the centre of the composition At the head of the tube and at right angles to it, is fastened a small tube of 10 oz copper, which contains the detonating charge, and which communicates with the main portion of the composition by a hole bored into the composition tube In the small tube is inserted a rubber or friction bar of 24 oz copper, having an eye on its outer extremity, above and below this bar, a small pellet of detonating composition is placed, and the tube is then firmly compressed together with pincers The finished tubes now receive a coating of black varnish, and a coating of paint, and finally another coating of varnish , they are then dried in a steam bath By this means the joints of the tube are rendered impervious to damp To ignite the tube, a lanyard, with a hook attached, is placed in the eye of the friction bar and steadily pulled

Frog—A horny wedge-shaped substance within the cavity of a horse's hoof The function of the frog is to share in the pressure on the foot, and by its elasticity, to relieve or distribute the pressure on the hoof The name is also given to that part of a soldier's accoutrements which is attached to the waist-belt for holding the sword bayonet

Front—As opposed to rear The front, with reference to an alignment, is the direction of the supposed enemy Used as a general term, the word signifies the direction in which soldiers face when occupying the same relative positions as when last told off The front in artillery is the direction to which the horses' heads turn when the battery is limbered up

Front of Fortification—Comprises all the works constructed on any one side of the polygon which surrounds the ground to be fortified

Frontlets—Screens of 3 inch plank, bound and faced with sheet iron, $\frac{1}{8}$ inch thick, and used to protect the gunners from musketry fire when laying the piece They are fixed over the vent fields of siege guns by means of iron stanchions attached to their sides, and running into loops on the cheeks of the carriages The lower part of the frontlet is cut out to fit the shape of the gun or howitzer, and a small notch made in the centre, as a sight through which to lay the gun Those for howitzers require the notch or split to be carried up high enough to use the piece at high elevations

Fugleman or Fugelman—A soldier placed in front of a regiment to give the time in the manual, platoon, or sword exercise The word is from the German *Flugel,* and signifies a wing , the man having been originally posted in front of the right wing

Fulcrum—The point of suspension in a balance, or axis of a lever on which the arm of the scales is balanced Levers are of three kinds, in each of which the position of the fulcrum depends upon the relation of the power to the weight See Lever

Fulminate of Mercury—($2 H G O C_4 N_2 O_2$) A salt of mercury with fulminic acid It is used in the manufacture of percussion caps It is of a highly explosive nature, and formed from the combination of mercury and nitric acid, mixed with chlorate of potassa The process pursued in the manufacture of Percussion Caps is as follows

Take of	Mercury	7oz	12drs
„	Nitric Acid	4 „	4 „
„	Alcohol .	4lbs	8oz

Mix these ingredients together in a glass retort, exposing them for a short time to the action of the sun, then place the neck of the retort into a receiver, being careful to close securely the point of junction with clay, so as to prevent any escape of the vapour arising from the chemical action of these ingredients This action will be seen to commence shortly after, by thick white vapour being thrown off through the neck of the retort into the receiver, where it becomes condensed As soon as this action of the ingredients ceases, the retort is removed, and at the bottom of it will be found a residuum, which is fulminate of mercury This is taken out of the retort and washed thoroughly with distilled water until all trace of acid is removed This is known by dipping litmus paper into the washings, when, it free from acidity, the paper will not change color, or when the water becomes tasteless The fulminating powder is then dried, not in the sun, but on sheets of long cloth, in a room, spread on trays of wicker or brass work When dried, it is packed away in small parcels, and the reason of this is, that from its explosive character it would be dangerous to heap it together in any quantity When required for use, it has to be mixed with chlorate of potassa and antimony in the following proportions

Chlorate of Potassa,	6 pts	by wgt
Fulminate,	6	„ ditto
Antimony,	4	„ ditto

It is then mixed and sifted in a fine brass sieve, having a leather bottom, with a fine hair brush

Fulminate of Mercury detonates either by a blow or at a heat above 370° Ft It detonates in a moist condition, and in a dry state explodes readily when struck or even when harshly rubbed

Funeral Honors—Only to be accorded to officers who, at the time of their decease, were on full regimental pay, or employed on the staff, or in the exercise of any military command

Funnel Stake—A tinman's iron for curving the tin plate

Furlong—Eighth of a mile, forty rods

Furlough — Leave of absence, granted to officers and others entitled to the same In India, furlough is granted to officers on private affairs or on sick leave either in the country or to Europe Officers belonging to the Indian army or on the staff, can, after eight years' actual service in India, take leave for two years On the completion of six years' further actual service, after return from Europe, they are eligible for a third year's furlough, and for a fourth or fifth year after similar intervals of six years

An officer drawing staff pay in addition to the pay of his rank, will be allowed while on furlough 50 per cent of his substantive appointment *

Officers not in staff employ will receive half the Indian pay of their rank, and in no case will any officer entitled to furlough receive less than the minimum of £250 per annum Short leaves are given in the country, to officers in general, for two months, without loss of pay and allowances, beyond that period, staff officers receive only half staff allowance Warrant officers are granted leave to Europe after six years' service in that rank, and after 15 years' service in India They are also allowed privilege leave in India for two months in the year, similar to commissioned officers

* Since the above order was published, it has been ruled that no absentee shall draw more than £1,000 per annum

Furnace—In the general acceptation of the term, any vessel or utensil for maintaining a strong and searching heat, either of coal or wood

Furnace, Reverberatory—Used for roasting or calcining metal ores in The principle of such a furnace is this, that a flame shall be produced, and reverberated or reflected down upon the mineral, this is usually done by burning a bituminous fuel in the grate, and the flame thus produced is reverberated upon the ore by the peculiar form which is given to the vaulted top of this kind of furnace, and also by the draught excited by a tall chimney

Furnaces, Shot—Those used in the Artillery Service are for heating spherical shot They are of two patterns, the ordinary furnace, and the improved shot furnace, the former containing in three rows alongside of each other, fifteen 32-Pr, or eighteen 24-Pr, or twenty-one 18 Pr shot, the latter, thirty-six 68-Pr shot

Fusilade—A general discharge of fire-arms

Fusilier—Formerly, a soldier armed with a short musket, which he could sling over his shoulder

The Fusilier regiments, of which there are eight in the British service, are not distinguished from the infantry of the line as they formerly were, the title is now purely honorary, and they are armed and dressed in every way as an infantry regiment, with this exception, that the non-commissioned officers wear chevrons on each arm On parade or marching in quick time, upon occasions of guard-mounting parade, or review, they march to the Grenadiers' March

Futchels—Are strong pieces of wood, three in number, uniting the splinter bar and the axle-tree bed of a gun limber

Fuze, Bickford—Consists of a very small tube of strong linen filled with gunpowder, and served round with tarred twine, and the whole pitched over It is procured in coils like small rope, and keeps very well It is not injured by damp, and will even burn, when well made, under water It burns regularly at the rate of 12 feet in 5 minutes Mines are usually fired, or, as it is technically termed, sprung, by a powder-hose or by Bickford's fuze

Fuze, Electric—The invention of Mr Abel, chemical examiner to the War Office It is used for mining purposes, and is on the same principle as the electric tube also invented by him The electric tube can be fired by means of a magneto-electric apparatus or "magnetic exploder" Electric tubes are used for firing guns at proof, and for other experimental firing, also for firing "time guns" For further information on these tubes, *vide* Majendie's Treatise on Ammunition, from which the above information is taken

Fuze, Freeburn—Is a concussion fuze, made of wood, with a composition bore down the centre, which is rather more than half filled with fuze composition, three small wedges of gun metal are fitted into the wood round the upper part of the composition, the larger end of the wedges being towards the composition When the shell is fired, the wedges, being supported by the composition, are not displaced by the shock of the discharge, but on the shell striking the object at a considerable range, the composition will have been consumed to some distance below the wedges, thus leaving them unsupported, and they will therefore fall into the composition bore, the flame at the same time making its way through the empty spaces into the shell.

Fuzes—As described by Major Miller, R A, in the Army Equipment,

Part II on Artillery, are an invention for igniting the bursting charge of a shell at any required moment

There are many varieties of fuzes, but those in the British service may be classed under two heads Time and Percussion, the former made of wood, and known as Boxer's Time Fuze, the latter of metal, and known as Pettman's Percussion Fuze for land, sea, and general service Also the C Field Service Percussion Fuze

Boxer's Time Fuzes, which are most generally in use in the British artillery, are adapted for all common and shrapnel shells of the larger natures of B L rifled ordnance, and for those of all M L guns They are designated, according to the length of time they burn, as the 5, 9, 10, 15, and 20 seconds fuzes

The conditions to be fulfilled in Time Fuzes are thus explained by Lieut-Colonel Owen —

(1) That they should ignite with certainty, (2) that they should burn regularly, (3) that, when ignited, they should not be liable to extinction on striking earth, water, or wood

Percussion Fuzes are used with segment shells, and other natures of projectiles, fired from B L and M L R guns, whenever it may be necessary to burst the shell on impact They are intended principally for naval service, the action of the fuze depending upon the striking of the shell against a substance which offers a very considerable resistance, such as the side of a ship

The essential requirements of a good Percussion Fuze are (1) that it shall not be ignited by the shock of discharge, (2) that it shall be ignited on the impact of the shell 'against the object', (3) that it may not be liable to explode during transport, and (4) that for *naval service* it shall not explode on striking water

We may now briefly notice the mortar fuzes of the service (Boxer's), which are of two sizes, that for the 13, 10, and 8-inch being the same, containing 6 inches of fuze composition, and which necessarily projects further from the fuze hole of the 8-inch than from the 13- and 10-inch, and a fuze containing three inches of fuze composition, same diameter as the diaphragm and common, made on the same principle as the 6-inch for the 5½ and 4⅖-inch shells The mortar fuzes are "bored into" through the side, and are secured at the top by a tin cap

It has been discovered in high trajectories, such as in Mortar Practice, that the pressure of the atmosphere being less than when near the ground, the fuze does not burn so quickly From experiments made, it appears that each diminution of one inch of barometrical pressure, causes a retardation of one second in a six-inch or 30 seconds fuze, or each diminution of atmospheric pressure to the extent of one mercurial inch, increases the time of burning by one-thirtieth, or in other words, the increments in time are proportional to the decrements of pressure

G.

Gabions—Open cylindrical baskets used for revetting the interior slopes of batteries and other field works There are three kinds of gabions,—the wicker, Tyler's sheet iron, and Jones iron band gabions They are described as follows in the Manual for Field Service —

"*Gabions, Wicker*—Open cylinders, of coarse basket-work, 2′ 9″ high, 1′ 9″ or 2′ 9″ in diameter, the smaller for saps, the latter for batteries, no larger size should be made Having set 12 pickets, each ¾ to 1 inch in diameter, in a circle, begin by inserting the ends of

three rods between three consecutive pairs of pickets, then weave them in and out, round the circle, taking care that they pass alternately over and under one another, and to carry each in turn outside *two*, inside *one* picket Each squad of three men requires one bill-hook, three gabion knives, one 4′ rod, one chopping block, one 3′ line, and sometimes a hand saw The rods for the web should be from ⅜ to ⅝-inch in diameter, of the most flexible material to be procured, and stripped of fine branches Three men turn out a 2-feet gabion in two hours, weight from 36 to 40 lbs" In India, bamboos are the best material for gabions, whole ones being used for the uprights, and split ones for weaving round them They are very easily and quickly worked up

"*Gabions, Sheet Iron, Tyler's*—A single sheet of galvanized iron, about 0 45 inch thick, 75½ inches long, 33 inches wide, with 4 eyelet holes, weight 28 lbs, requires no pickets The sheet is rolled into a cylinder for use, the ends secured by strong wire ties The noise which is made by the gabion when carried empty, is a drawback from its general advantages The sheets may be used for roofing and other purposes"

"*Gabions, Iron Band, Jones'*—Each gabion is made of 10 bands of galvanized sheet iron, worked over 12 wood pickets, the ends brought together and connected by 2 buttons at one end, fitting into 2 slots at the other Each band is 77 inches long, 3¼ inches wide, of No 20 gauge, or about 0 05 inch thick, weight of ten, 29 lbs The buttons and button holes are required to stand a weight of 672 lbs, the band itself will support about 1,500 lbs, each band has 4 holes to admit of combination to form bridges, beds, stretchers, and for other incidental applications little or no instruction is required for making these gabions"

Gages, Common—For setting out lines and grooves parallel with the margin of the carpenter's work The "stem" of the gage is retained in the head or stock by means of a small wedge, and the cutter is fixed in a hole at right angles to the face of the stem by another wedge There are several forms of gages, such as the marking, cutting, router, mortise gage, &c

Gaining Twist—Some of the rifles and rifled ordnance in the service are made with grooves which have a very slight twist at the breech, but the twist is increased regularly until it reaches the muzzle, this is known as the "gaining twist" At the instant of discharge, when the ball, from a state of rest is instantly given a high velocity, it would seem likely to be pushed across the grooves, especially if they have a great inclination To avoid this, the inclination of the grooves is made slight at the breech, and increased gradually toward the muzzle, at which point they are sufficiently inclined to give the necessary rotatory motion The advantage also in the increasing twist is that, as the projectile leaves the seat or chamber of the gun with great velocity, it relieves the breech a good deal from the strain of the discharge

Galena, or Sulphide of Lead—Is the most abundant ore of lead known It is found in different parts of Great Britain, and in the continent of Europe It has usually a metallic lustre, or a leaden gray or blackish gray colour, and its structure is lamellar The principal varieties of this mineral are specular galena and blue lead It is used in the laboratory, and forms one of the ingredients in the composition of blue lights.

Gall—The wound inflicted on draught horses from the imperfect fitting of the harness Saddle galls are the most common. For the prevention of galls, *vide* Pad

Gallery—In fortification, the passage formed under ground from the end of the shaft in mining and countermining Great galleries are those used in the attack of fortresses for descending from the crowning of the covered way into the ditch In a system of countermines, the gallery, which runs parallel with the counterscarp, and is the base of the system, is known as the *magistral* gallery, that which is parallel to it, and beyond it, is the *envelope* gallery, those that connect these parallel galleries, are *galleries of communication*, and all those pushed into the country, beyond the envelope gallery, are *listening* galleries For further information, *vide* Aide-Memoire

Gallop—The quickest pace of a horse, which is about eleven miles an hour or upwards

Galloper—A light gun, of small calibre Formerly galloper guns were attached to infantry regiments The employment of these guns has long been abolished

Galvanic Tube—The following description is given in Major Owen's Lectures on Artillery —"The barrels of these tubes are of quill, the cup, which is of wood, is fixed on the large end of the quill, and has two pieces of copper tubing passing through it, connected together inside the cup by a small platinum or steel wire, over which the priming is placed When the tube is placed in the vent of the gun to be fired, the ends of the two wires from the battery are inserted into the copper tubes, one in each, upon the circuit of electricity being completed, the small wire within the cup becomes red hot, in consequence of the resistance which it offers to the passage of the electricity from one wire to the other, and thus ignites the priming" These tubes were used for the "proof" of ordnance They are superseded now by Abel's electric tube

Galvanism—A branch of electricity, named from Galvani, an Italian, in which electrical phenomena are exhibited without the aid of friction, and a chemical action takes place from the contact of certain metallic and other bodies The subject was subsequently treated by Volta, and has since been denominated indiscriminately Galvanism or Voltaic electricity Galvanism is much used in the Arts

Galvanized Iron—Is iron covered with a coating of zinc, either by the electro process, or by the application of an amalgam of zinc and mercury to the surface of chemically cleaned iron The latter is called Mallet's patent process

Gardens, Military—Are sanctioned for the employment and amusement of troops in cantonments in India The produce of these gardens is bought by the Commissariat Department and given to the soldiers

Garlands—*Vide* Shot Garlands

Garnish Plate—That part of the iron work of an artillery carriage which covers the upper surface of the brackets

Garrison—The troops left within a fortified place for its protection

Garrison Artillery—Comprises the ordnance placed on the works of a fortress, and the men for working the guns within it The ordnance used in such a position are for the most part heavy artillery, rifled and smooth-bored, of different natures and sizes

Garrison Carriage—*Vide* Carriage

Gas—An aeriform fluid, but differing from the air of the atmosphere The gas used for inflating balloons with is common coal gas, the specific gravity of which is 0 4, common air being 1 0 When this is not procurable, as, for instance, in the field, where balloons might be required for military purposes, hydrogen gas should be used, which is procured by passing steam through iron cylinders charged with iron turnings, and heated to redness in some simple kind of furnace By this means the steam is decomposed, its oxygen uniting with the iron, while the hydrogen is disengaged The latter should be passed through a reservoir of caustic lye before it enters the balloon

The gas produced by the explosion of gunpowder consists of carbonic acid, carbonic oxide, nitrogen, the sulphide, cyanide, and sulpho-cyanide of potassium, carbonate of potash, hydrosulphuric acid, bi-sulphide of carbon, and aqueous vapour Its temperature is estimated at 2192° Fahrenheit, and its volume at that temperature is more than 2,000 times that of the powder

Gasket—In artillery, a plaited cord used for "stoppering the fall" It may also be made (on the same principle as the *selvagee*) by placing a number of rope-yarns in a straight line and marling down

Gates—In field works, gates called "Barrier Gates" are used to close the entrances They should be made very massive, and capable of resisting any sudden attack

Gatherers—The fore-teeth of a horse

Gatling Battery—*Vide* Supplement

Gauge, Iron Cylinder—Is adapted for testing the body, studs, and pitch of rifling of muzzle-loading projectiles, at one operation.

Gauge, Ring Standard—An instrument for adjusting the "star gauge," which is performed as follows —The handle is loosened, the proper measuring points are screwed in, the ring gauge placed on them, and the slider pushed out until all the points touch the inner circumference The zero of the scale is then made to coincide with the mark on the tube, and the handle clamped, when the instrument is ready for use A rest in the form of a T is placed in the mouth of the gun to keep the instrument in the axis of the piece Commencing at the muzzle, the diameter of the bore is measured at intervals of a calibre as far as the trunnions From that point to the seat of the shot, a diameter is measured at every inch, and for every quarter of an inch for the rest of the bore No variations over 0 03 of an inch are allowed, and that must be in excess

Gauge, Trunnion—An instrument used for measuring the diameter of the trunnions

Gauges, Cartridge—A gun-metal ring of the required size, with a handle on which is stamped the nature and size They are used for examining filled cartridges, to ascertain if they are of the proper dimensions, and are made of 13 different sizes

Gauges, Rocket—Brass rings, which are used to ascertain whether the case is exteriorly of the proper dimensions

Gauges, Shot or Shell—Are used for ascertaining the measurement of spherical and elongated projectiles The former consist of a ring of iron, with a metal handle, for determining the diameter of the shot or shell Only one

high gauge for each calibre is issued The projectiles should pass in all directions through the high gauge, but must not pass through the low gauge

Low as well as high gauges are issued to fire-masters and inspectors of warlike stores, and store stations

Gauges, Vent—Are used for ascertaining the inclination of the vent of a piece of ordnance They consist of two pieces of steel wire, greater and less than the true diameter of the vent by 005 of an inch Variations in excess reaching to 025 of an inch are allowed

Gauntlet—Armour for the hand and arm, made either of scales or mail The expression to "run the gauntlet' is derived from an ancient custom in the navy of making a criminal run between two ranks of seamen, and be lashed by each man *Vide* Run the Gauntlet, or Gantelope

Gear — The name given to the clothing, head, and heel ropes, &c, of horses, termed "stable gear," and to the pads and trappings used with bullocks, camels, elephants, and mules, in draught or in carrying loads

The term is also used when machinery is in motion, in the engagement or disengagement of its parts, such as lifting a wheel *out of* gear and throwing a wheel *into* gear Machines are engaged or disengaged while in motion by various means, such as the "sliding pulley," "fast and loose pulleys," &c

Gear also implies all apparatus for the lifting of heavy ordnance, and for the traversing and training of guns, &c

General — The highest rank given to an officer in the army next to that of field marshal As defined in Brande and Cox's Dictionary, the name designates his command, as having the *general* or highest orders to give in battle In the British army there are three ranks—the highest, *General*, the second, *Lieutenant-general*, the junior rank, *Major-general* The title of Brigadier-general is only a temporary one Colonels of regiments are always general officers

Generale—Beat of drum for the assembly of all the troops preparatory to a march, battle, or action Fire drum, when beaten unexpectedly, is the signal for the whole of the troops to assemble at the alarm posts

Genouillere—In a battery, that part of the parapet reaching from the platform to the sill of the embrasure In a barbette battery, it is the height of the crest of the parapet above the platform

Gentlemen-at-arms — A small body-guard of about forty men in attendance upon the Sovereign on state occasions It formerly consisted of men of noble blood, but is now recruited from retired officers of the army

Geometrical Progression—Quantities are said to be in geometrical progression, when every succeeding term is a certain constant multiple or part of the preceding term Thus a, ar, ar^2, ar^3, &c, is a geometrical series of which r is the constant multiplier, called the "ratio" In such a sum the nth term $= l = ar^{n-1}$, and the sum $= a\frac{r^n - 1}{r-1} = \frac{rl - a}{r-1}$

Ghurrie—An Indian term, a circular plate of gun-metal, issued to troops in India in the proportion of one per regiment, for striking the hours. Ghurries are made up at the Gun Foundry, Cossipore, and are 8 inches in diameter, $\frac{6}{10}$ inch thick at the edge, and $\frac{8}{10}$ inch in the centre, with one

side slightly convex Their weight varies from 35 to 40lbs

Gimbal—A mechanical contrivance for keeping a suspended body vertical, whatever be the derangements to which the points of suspension are liable It consists of two brass rings which move within one another, each perpendicularly to its plane about two axes, placed at right angles to each other

Gimlet—A fluted tool, which terminates in a sharp worm or screw, beginning as a point, and extending to the full diameter of the tool, which is drawn by the screw into the wood The principal part of the cutting is done by the angular corner intermediate between the worm and shell, which acts much like the auger The gimlet is worked until the shell is full of wood, when it is unwound and withdrawn to empty it

Gin or Gyn—A machine for lifting heavy weights, and especially for mounting and dismounting ordnance from their carriages, &c There are two patterns, the 18 feet and the 16 feet gyn, made of wood, the latter is applicable only to mounting guns on travelling or standing carriages, platforms, wagons, &c, two are required with all guns heavier than 56 cwt In 1860, Captain Farmer, R A, proposed a tubular wrought-iron gyn Twelve were ordered to be made and issued to different stations to be reported on The gyns were 18 ft, and made for the heaviest gun then in the service, namely, the 68 Pr of 95 cwt but it appears that it will just bear a 7 ton gun

The report was most favourable, and the gyns have been admitted into the service, as well as a similar gyn by the same inventor capable of mounting a 12½ ton gun A gyn is composed of a prypole, which is the front of it, and two legs, with a windlass fixed between them, which is termed the rear of the gyn, forming the figure of a triangle when set up, hence its name, "triangle gyn" It is recommended with regard to the iron gyns, that for garrison purposes the legs and prypoles should be in one piece, without a joint, but for siege purposes and batteries of position, the legs and prypoles should be jointed for the greater convenience of transport

There are two other pattern gyns in the service, *viz*, the Gibraltar gyn, and Bell's gyn The former is of a different shape to the "triangle gyn," and is used for mounting and dismounting ordnance in casemates and in low covered batteries where the triangle gyn, from its height, could not be conveniently placed This gyn is not capable of lifting more than 3 tons

Bell's gyn is similar in form to the Gibraltar gyn, but the method of lifting the gun differs This gyn is not strong enough to bear more than 1½ tons

Girders—The longitudinal beams in a floor, girders are the chief support of a ground floor, their depth is often limited by the size of the timber, but not always so Girders of wrought and cast iron are now extentensively used in the construction of bridges, to girt railroads, canals, &c, and many of them are of considerable span

Girth—A band or strap made of web passing round a horse underneath his belly, and which keeps the saddle in its place The term is also used with reference to the circumference of timber, &c

Glacis—In a fortification, the parapet of the covered way extended in a long slope to meet the natural surface of the ground, so that every part

of it shall be swept by the fire of the ramparts

Glanders—A disease horses are subject to Mayhew, On the Horse, states that it is "brought on by stimulating food, combined with exhausting labour, damp and want of ventilation will also produce it The disease termed farcy is glanders, only modified by the cause that originates it Glanders is the more vigorous form of the disorder, farcy is the slow type fastening upon general debility The disease is highly contagious, and though a stable may be perfectly clean, yet this poison may have been lodged there by the last inhabitants it is not only contagious to horses but equally dangerous to men Running from the nose indicates very often the setting in of the disease, but the following signs appear when glanders exist a staring coat, bad appetite, and the pulse is quickened, and soon afterwards a slight discharge from one nostril, this is followed by one of the sympathetic glands, on the same side as the moist nostril, altering its character The next change that takes place is the disappearance of the transparent fluid from the nose, which is succeeded by a full stream of unwholesome pus When the third stage is witnessed, the disease is rapidly hurrying to its termination The membrane of the nose changes to a dull leaden color, the margin of the nostrils becomes dropsical, and every breath is drawn with difficulty The defluxion exhibits discoloration, scabs, masses of bone, or pieces of membrane, mingled with patches of blood, next make their appearance, and the internal parts are evidently being broken up by the virulence of the disorder It is an incurable disease, and the horse should be shot at once"

In the Indian Military Regulations, it is ordered, that at all stations where farcy, glanders, or other infectious diseases have shown themselves, the cattle are to be carefully examined, at least twice a month, under the orders of the Commanding Officer, with the view of detecting these disorders, and until no indications whatever of their continued existence remain in the corps in which they have appeared

Glazing — A process to which gunpowder is subjected, it adds somewhat to its durability and to its density, and by reducing the grains to nearly the same size, gives uniformity of range, combustion being more equalised, powder also, by being glazed, stores and travels better The process of glazing follows that of dusting The barrels used for glazing contain about 400 lbs of powder, and make from 32 to 38 revolutions in the minute The time expended in glazing depends upon the nature of the powder A little graphite is placed in each barrel to assist in giving a polish to the grain It is found in India that the mere friction of the grains against each other will not impart a glaze

Glue—An impure desiccated gelatine, procured from various sources, such as the scraps of ox and other thick hides, the debris of tan yards, the tendons and intestines of many animals, rabbit skins deprived of their fur, scraps of parchment, old gloves, and many other apparently worse than useless matters, all contribute their quota in the manufacture of "glue" It is an invaluable substance in fixing together all kinds of wood-work

Glue, Liquid—A useful cement, and withstands damp much better than the common glue It is prepared as follows "Dissolve one ounce of borax

in a pint of boiling water with two ounces of shellac, and boil in a covered vessel until the lac is dissolved "

Glue, Marine — A cement That known as Jeffery's Patented Marine Glue is a compound of india-rubber, shellac, and coal-tar naphtha It is remarkable for its great strength The colour of this glue, however, unfortunately prevents its being much used The interior of diaphragm shells is coated with it, so as to fill up any interstices which there may be between the diaphragm and the socket This glue also prevents the shell deteriorating from rust

Glue, Mouth—Used for uniting papers and for gluing down paper to plan or drawing boards It is made by dissolving pure glue by the aid of heat, such as parchment glue or gelatine, with about one quarter or one-third of its weight of coarse brown sugar, in as small a quantity of boiling water as possible This, when perfectly liquid, should be cast into thin cakes on a flat surface *very* slightly oiled, and as it cools, cut up into pieces of a convenient size

Gnomon—The hand of a sun-dial It is placed at such an inclination with the plate of the dial, that, when properly set, the gnomon will be directed to the north pole of the heavens, and its shadow will fall upon the same lines of the dial at the same hours, whatever be the season of the year, that is, for one particular latitude, but dials must be differently constructed for places which have different latitudes It is shown in astronomy that the elevation of the celestial pole is equal to the latitude of the place, and, consequently, the inclination of the gnomon of a sun-dial must be also equal to the latitude of the place, where the dial is intended to be set. It follows, therefore, that a dial constructed for London would not be suitable for Edinburgh *Vide* Lardner.

Goloshes, Leather — Are intended to be worn in magazines and buildings containing combustible stores The golosh is a large, loose, untanned leather boot, the high sides of which extend a considerable distance up the calf of the leg They are made of sizes, suitable to cover magazine shoes, and are used when working amongst loose powder

Golundauze—An Indian term for an artilleryman The name is derived from two Persian words—*gol*, a ball, and *andakhtun*, to throw

Gomer Chamber—A conical chamber which is joined to the cylinder of the bore by a portion of a spherical surface It is so called from the French officer who invented it, and has been applied, since the year 1820, to all shell guns, howitzers, and mortars manufactured since then

Good Conduct Badges—Marks of distinction for good conduct, which are bestowed with each penny a day The badges are worn by soldiers above the elbow, with the points up

Good Conduct Pay—A reward of additional pay to soldiers, for good conduct It is granted under the following circumstances —A soldier whose name does not appear in the Regimental Defaulters' Book for at least two years preceding his claim, receives—

After 2 years	1*d*	per diem
After 6 ,,	2*d*	,,
After 12 ,,	3*d*	,,
After 18 ,,	4*d*	,,
After 23 ,,	5*d*	,,
After 28 ,,	6*d*	,,

Sergeants receive as rewards for distinguished or meritorious services annuities and medals, either while serving, or after discharge

Gorge—An entrance in the rear of a fortified work, such as a bastion, redan, &c

Gouge—A curved chisel Gouges are used not only by the carpenter and joiner, but a great variety by the turner, who employs them for roughing out and forming the work

Gouges, Firmer—Fluted instruments for boring circular holes by the application of a mallet on the head of the wooden handle Gouges are of different sizes, from ⅛ inch to three inches For turning soft woods, gouges are also used, they differ, however, from the carpenter's gouge, in having no shoulders, they vary from ⅛ inch to two inches wide

Governor of an Engine—As described in Baker's Elements of Mechanism, is one of the most important regulators of a steam engine, it consists of a series of jointed rods, which play upon a vertical spindle, having at the extreme points of the rods two balls It is connected with the throttle valve of the steam engine by a lever, and the proportion and position of the rods are so adjusted, that when the balls descend to their lowest position, the throttle valve opens, and when they separate, it becomes gradually closed A grooved wheel, or oftener a toothed pinion, is fixed upon the axle of the spindle, which receives its motion from any convenient part of the machinery Suppose then the load of the engine to be suddenly diminished, or the force of the steam increased, then a momentary augmentation of speed will take place in the piston, and, consequently, an increased velocity will be imparted to the wheel and balls of the governor, these balls will, therefore, fly further from the spindle, the fork will be drawn down, the throttle valve partially closed, and the supply of steam to the cylinder diminished If, on the contrary, the load of the engine be increased, or the force of the steam diminished, the speed of the piston will be momentarily slackened, the velocity of the wheel diminished, the balls will descend and approach the spindle, the fork will be raised, and the valve be partially opened In this manner the governor has the effect of admitting at all times to the cylinder just that portion of steam that is necessary to give the piston its proper speed, the quantity being always proportioned to the load of the engine

Governor-Gener l of India—The chief executive officer of that dependency, and who is appointed by the Crown for a period of five years, which however, can be extended The Governor-General is subject in all matters of moment to the control of the Crown, through the Secretary of State for India He is assisted by an Executive Council, composed of five members, viz two Civilians, a Law and Financial Member, and a Military Member All acts of the Government are performed in the name of the Governor-General in Council," not that he is necessarily bound to the majority of the votes of his Council, as he can dissent altogether from their opinion, and act accordingly if he thinks fit

The above members, with the addition of a Civilian from Madras and Bombay, and a few non-official members selected from the European commercial community, and with one or two native noblemen, constitute the Legislative Council But the Governor-General, it is believed, has the power of making rules and regulations, on an emergency, of his own independent authority

Grade—In a military sense, signifies the different ranks in the Army, both commissioned and non-commissioned

Gradient—As defined in Francis' Dictionary of the Arts and Sciences, is a term indicative of the proportionate ascent or descent of the several planes upon a railway, thus, an inclined plane, 4 miles long, with a total fall of 36 feet, is described as having a gradient of 1 in 587, or 9 feet per mile

Graduate—Anything marked in degrees of equal parts, as distinguished from the division into inches, or other certain and determinate measurements Hence, in graduating an instrument, the length of the degree is in proportion to the size of the instrument, but a measurement in inches, &c, has no reference to the length of the scale employed

Gram (*Cicer Arietinum*)—A name given in oriental commerce to the produce of two leguminous plants cultivated in India, and chiefly used for feeding horses, bullocks, &c

Granulation—Is that operation in the manufacture of gunpowder which follows the process of pressing the cake, whereby it becomes reduced to grains of different sizes, according to the sieves used The reduction of the press cake into the form of grains is effected by means of toothed rollers (three pairs of different degrees of fineness being used), the cake passing between each pair of rollers, under which is a screen covered with a certain sized mesh wire, in addition to these screens, as in the Waltham Abbey granulating machine, there are three oblong sieves covered with different sized wire, and cyprus cloth, respectively, fixed under and parallel to each other, running at an incline just below the three pairs of rollers This arrangement permits of the powder being dusted, as well as granulated, by the same machine

Grape Shot—That at present known in the Service, is "Caffin's pattern," which has been substituted for "quilted grape" It consists of sand shot, arranged in three tiers, by means of three cast-iron circular plates, and a bottom plate of wrought iron, the whole is secured firmly together by means of a wrought-iron pin, which passes through the centre of the plates The number of shot in each tier varies from three to five, according to the nature of gun for which the grape shot is intended The advantage of grape over quilted shot is, that it stows better, is more easily put together, and more durable, and the effect is considered to be greater It was formerly much used in the navy, but the issue of it to that service seems to have ceased in 1866 In the attack and defence of works, it would still be used from smooth-bore guns, and is effective up to 600 yards

Graphite — Commonly called black lead, is described in Abel and Bloxom's Hand-Book of Chemistry, as another crystalline modification of carbon, very different in appearance and physical properties to the diamond It is found in Cumberland, Siberia, Ceylon, in Germany and France, and in North and South America Graphite is a very good conductor of electricity, like the diamond, it is unalterable by heat It may be prepared artificially by bringing an excess of charcoal in contact with fused cast iron, a portion of the carbon dissolves, and separates out again on cooling in large scales

Grapnel — A small anchor of several flukes, used in mooring boats or pontoons for military bridges

Grass-Cutters—Natives of India attached to the Artillery and Cavalry branches of the Service in that country, whose sole duty is to collect and bring in grass daily for the

horses. There is one to each horse or one to every two horses, termed a *jorawallah,* who receives the pay of two men, but under these circumstances he has to keep a pony, and bring in grass equal to the load of two men. A grass-cutter's pay is from eight to ten shillings a month.

Gravimeter—A brass cylindrical measure, 4 inches in diameter and 5.093 inches in height, containing 64 cubic inches, or 1-27th of a cubic foot. It is used for approximately determining the density of gunpowder by taking the weight of a given quantity, which is called the *gravimetric density.* The weight of the contents of the gravimeter should be ascertained with the powder loose and shaken; the difference gives an indication of the relative irregularity and size of grain.

Gravity—Is a term used to denote that force by which every material particle is urged towards the surface of the earth as soon as it is left unsupported. The intensity of the force of gravity is constant at the same place, and it is a uniform force which accelerates all bodies equally.

Gravity, Centre of — That point in bodies through which the resultants of the gravity of their particles pass. A line drawn in the vertical direction through the centre of gravity of a body, is called the line of direction of the centre of gravity. In a spherical shot of equal density throughout, the centre of gravity will be in its centre of figure, but as it is almost impossible to cast solid shot of perfect sphericity and density, its centre of gravity will be formed either above, below, or to the right or left of its centre of figure. In hollow spheres, such as shells, the centre of gravity is an imaginary point within the cavity of the shell. In irregular figures, the centre of gravity sometimes falls without the dimensions of the body.

Gravity, Specific—As defined in Francis' Dictionary of the Arts and Sciences, is the relative gravity of any body or substance, considered with regard to some other body which is assumed as a standard of comparison, which standard, by universal consent, is rain-water, this kind not being subject to much variation from time, place, or other circumstances. One cubic foot of rain-water weighs exactly 1,000 (avoirdupois) English ounces; hence *the relative weights of other bodies* is easily referred to this standard. The following table showing the specific gravity of the under-mentioned solids and liquids will be found useful:—

Water	1000
Platinum	21.5
Gold	19.5
Mercury	13.5
Lead	11.45
Silver	10.5
Copper	8.96
Iron, Cast	7.2
Iron, Rod	7.7
Steel	7.8
Diamond	3.5
Rock Crystal	2.6
Window, Glass	2.52
Wax	0.964
Sulphuric Acid	1.84
Oil of Turpentine	0.865
Spirit of Wine (strong)	0.83
Ether	0.72
GASES	
Atmospheric Air	1.000
Oxygen	1.106
Hydrogen	0.069
Nitrogen	0.972
Carbonic Acid	1.524
Carbonic Oxide	0.967

Grazing Fire—When the trajectory is low and nearly parallel to the ground, and when the projectile strikes

the object, whether vertical or horizontal, at a less angle than 10°, this is termed *grazing fire*

Grease—The lubricator used for the axle arms of gun carriages It is composed of tar and tallow (mutton fat), one-third of the former to two-thirds of the latter This composition has since been changed for a mineral grease, consisting of the heavier products obtained in the preparation of paraffin or petroleum oils

In the veterinary art, the term grease is applied to a complaint which horses are subject to, the treatment for which is as follows 'Cut the hair close, apply finely powdered dried charcoal, and poultice over it, give physic and diuretics, when pain and discharge cease, apply dry bandages, astringent applications are sometimes useful, exercise is desirable when the legs are much swollen, procure green food, if possible' *Vide* Small's Veterinary Tablet

Greek Fire—A combustible composition used in ancient wars, which has the power of burning under water It is said the Greeks were the first to use it Its power appears to have been greatly exaggerated It is supposed that the following ingredients entered into its composition the gum of the pine and other resins pulverized, with sulphur, naptha, camphor, petroleum, and other bituminous substances The Americans used it in the bombardment of Charleston, as prepared by Mr Levi Short His so-called Greek fire consisted of two kinds, one of which was a dry composition, the other liquid The former was composed of saltpetre, sulphur, and lamp black, driven into a little iron tube, about three inches in length, and half an inch in diameter, and open at one end The composition was pierced a short distance up its centre with a fine hole, and burnt therefore with considerable violence from the open end The outside of the tube was covered with pitch with the object of creating a flame A number of these tubes were placed inside a shell with the bursting charge, which was ignited by a fuze in the ordinary way The explosion of the bursting charge opened the shell, and ignited the little tubes of "Greek Fire" which were thus scattered about among the enemy

The liquid kind of Greek fire was of coal tar naptha, which was thrown in shells, or through a hose, like water

Grenades—As explained in Captain Majendie's Treatise on Ammunition, are small shells filled with powder, having a fuze fixed in them, they are of two sizes, the land service or 3-Pr, and the sea service or 6-Pr hand grenade The former are much used in the defence of places against assault, being thrown among storming parties into crowded ditches, and the latter against masses of men attempting to board, or under any other such circumstances in which they can be made available They are also fired in vollies from mortars

Grenadiers—This name was originally given to soldiers who threw grenades, but as shown in Brande and Cox's Dictionary, it was afterwards conferred on certain troops of the line, distinguished by peculiarities of dress, accoutrements, &c The name originated with the French, and subsequently was adopted into all the armies of Europe Generally the tallest and finest men were selected for the grenadier company, until very lately there was a grenadier company in each regiment in the English army, but there is no such company now, and the name of grenadiers only exists in the Grenadier Guards

Grindstone—A circular stone supported in a frame-work of wood, which is turned by a crank handle It is used for sharpening tools

Gripes—A complaint horses are subject to "On the horse being observed to be in pain, he should be trotted about until his bowels are emptied Should this fail, he must be bled to the extent of two or three quarts, and a ball composed of one drachm of gum opium and two of powdered ginger, made up with bruised meal, given to him, and a clyster of oatmeal gruel every two hours"—*Vide* Small's Veterinary Tablet

Groove — A furrow or narrow channel cut in a spiral direction on the interior of a gun barrel, such as is observed in rifled ordnance and small arms —*Vide* Rifle

Grummets—Circular pieces of rope attached to shot to keep the shot steady in the bore They are made of various sizes Grummet wads are also used when firing at angles of depression, or at angles of elevation less than 3°, the grummet is placed over the shot to prevent it from running out of the piece The use of grummet wads with rifled muzzle-loading guns has been discontinued for land service, except when these guns are firing at a depression The term grummet is applied to a rope ring worked in a particular manner

Guard—As understood in time of peace, and in a garrison or cantonment, is a body of men daily told off in a regiment to protect any particular post or spot, or Government property, or to quell petty disturbances, and to take charge of men placed in confinement for any fault or crime There are a variety of duties attached to a guard, which are fully detailed in the Queen's Regulations There are further many natures of guards, placed and named with reference to the duty they are employed on

Guards—Comprehend a body of troops raised for the protection of the Sovereign in England, they are called 'household troops' The potentates of all countries have had body-guards attached to them from the earliest times In the British Service, the Horse and Life Guards with the Foot Guards form the household troops of the Sovereign Though these troops are virtually the protecting guards of the Sovereign, they are, nevertheless available for active service whenever required The Life Guards, it will be remembered, distinguished themselves greatly at the battle of Waterloo in 1815

Guddeelah—Indian name for a padded cloth placed on the back of a draught elephant before the harness is put on It is made of kurwah cloth stuffed with cotton, the edges being bound with leather

Gudgee—An Indian cloth used in the lining of native tents

Gudgeons—The circular parts of shafts or axles upon which wheels revolve The gudgeons in cast-iron axles are simply parts of the extremities of the axles turned exactly circular in a lathe The circular apertures in which the gudgeons turn, are called "brasses," they are made of a composition of copper and tin, and are very durable, as well as not readily worn by the friction of the iron axles The beams in which the brasses are fixed are called "bearings"

Guerillas—Small bands of men raised by the Spaniards in the Peninsular campaign, who fought in detached bodies against the French, harassing them in the mountainous defiles of that country This desultory sort of

warfare was most damaging to the enemy The warfare carried on by the French Franc-tireurs in the late continental war may be likened to that carried on by guerillas, with this exception, that they were formed into regiments, and fought in regiments, but when necessary were detached in parties all over the country

Guides—In Artillery carriages are two pieces of wood-work of a limber, the ends of which receive the tongue of the pole, and are termed fore guides or futchels There are also hind-guides, two strong pieces of wood together forming a fork, for securing the perch to the hind axle-tree of a four-wheel carriage The hind-guides are mortised into the axle-tree bed and bolster

The name "Guides" is also given to a regiment of cavalry and infantry attached to the Punjab Irregular Force, which were raised by the late Sir Henry Lawrence, chiefly with the view of their acting as scouts, and obtaining every available information about the country they may be in, and to act in expeditions as avant couriers to the force to which they belong, and also (the cavalry branch) in carrying orders which require despatch

Guidons—The standards of dragoon regiments, on which are embroidered the devices distinctions, and mottoes of the Regiment

Gun—The term gun has been often applied indiscriminately to ordnance of all natures , the name, however, was formerly confined to that species of ordnance especially adapted for throwing solid shot, though guns have been so modified as to carry shell equally well

The general shape of a gun is that of the frustrum of a cone, the bore being a cylinder , the thickest portion of the metal is at the breech, from which it tapers to the muzzle , and this form is necessary, as at the breech the gun has to stand the first shock of the elastic force of the gunpowder, which diminishes in power as it extends towards the muzzle

In the manufacture of our rifled guns, which are built up of a succession of coils, the same principle is observed as in smooth-bore guns, *viz* , the thickest proportion of the metal being at the breech The bore is also a cylinder, but modified, and made either of steel or iron, on which coils of wrought iron are shrunk The thickness of metal varies with the nature of projectile and charge, the larger the calibre of the gun, the greater will be the strain exerted on the piece The length of the bore should be such as to allow the whole of the charge to be consumed The length of guns in the British service varies from twelve to twenty calibres, all smooth-bore guns being seventeen calibres long As regards preponderance, there is very little given to our rifled guns, it being found that a gun can be more easily worked without it

Guns began to be used in Europe early in the fourteenth century, and as shown in the article under the head of "artillery," were very rough specimens of the art Within the last century the manufacture of ordnance has improved immensely, cast-iron guns, during this period, being our chief service cannon The manufacture of B L and M L guns is of recent date, the former having preceded the latter under the able superintendence of Sir W Armstrong, the inventor of the coil system To him is due in a great measure the improved condition of our artillery, for though it has been found that the breech-loading system is unsuited for guns of heavy calibre, we

owe to Sir W Armstrong the use to which he has put wrought iron in their manufacture His light guns have done good service, and remain to the present day our light artillery, but will soon be superseded, as the Armstrong method of closing the vent has been found somewhat complicated, and entails a staff of artificers, moreover, it has been proved that no advantage is gained in using a breech-loading instead of a muzzle-loading field gun Within the last few years it has been stated, and doubtless with much truth, that our heavy breech-loading cannon will not stand the charge which it is necessary to give them, but now that a new powder (pebble) has been introduced, exerting half the pressure of R L G, it may be the means of re-introducing heavy B L guns, for there is no doubt as regards heavy guns in battery and on board ship, that the breech-loading system saves time, exposure, and labor

A clever "Military Correspondent" has lately stated that another objection to the heavy breech-loader is the back smoke on opening the breech, in the open air this does not appear an objection, and on board ship between decks, this drawback could surely be overcome

Whilst this work has been going through the press, information has been received of the successful manufacture at Woolwich of a 35 ton M L rifled gun, carrying a shot of 700 lbs, with a charge of 120 lbs of pebble powder The initial velocity is stated to have been 1,320 feet per second, and the gun appears to have borne the proof of 130 lbs most satisfactorily

Gun-Cotton — Is the invention of Professor Schonbein It is prepared by soaking cotton in three parts of sulphuric acid (sp gr 1 85), and one part nitric acid (sp gr 1 45 to 1 50) The excess of acid is poured off, and the cotton thoroughly washed in running water When partially dried, it is washed in a diluted solution of carbonate of potass Afterwards it is put in a press to free it of the alkaline solution, while at the same time the cotton is rendered nearly dry The substance is then washed in a solution of pure nitrate of potass, and afterwards pressed and dried The explosive force of Schonbein's gun-cotton is nearly three times greater than that of gunpowder Some years back, experiments were made in England with Schonbein's cotton, but it was found to explode so instantaneously, that it was rejected for gunnery purposes Since then, however, General Von Lenk, of the Austrian Service, has discovered the means of giving gun-cotton any velocity of explosion, from 1 foot per second to 1 foot in $\frac{1}{1000}$th of a second It appears that by opening out the cotton, and allowing it to occupy a larger space in the bore, it can be made to act even more slowly than gunpowder

Another mode of treating gun-cotton has been applied by Mr Abel, the scientific chemical examiner at the War Office, who has been able to use gun-cotton in a granular form, from having first rendered it into a state of pulp, and afterwards formed it into grain similar to corned gunpowder The experiments have shown improved results compared with former specimens of gun-cotton, but it has not as yet been perfected, so as to render it safe for use in artillery For mining and sporting purposes it may be considered a success

From a late letter by the *Pioneer's* Military Correspondent, it appears that a committee, of which Colonel

Gallwey, R E, was President, has had the subject of gun-cotton under its consideration for some time, and has reported most satisfactorily on it, which has led to its being definitively adopted for many destructive and other purposes, including torpedoes The report of the committee was to the following effect —For the demolition of revetments and the formation of breaches by mines, gun-cotton is considered superior to gunpowder in the proportion of 5 to 2 For the demolition of single stockades, gun-cotton at the rate of 7lbs per lineal foot of the stockade is effective, even where the timbers are from 12 to 14 inches square In the demolition of double stockades, with 3 feet 6 inches between the rows, 25lbs of cotton per foot is required, in a trial with gunpowder, 200lbs failed to make a practicable breach

For the hasty demolition of bomb-proof buildings, gun-cotton is pronounced to be most valuable It is equivalent to nearly six times its weight of gunpowder For earth mines and countermined works, gun-cotton is not recommended It does not exert in earth such an upheaving power as gunpowder, and the gases generated are injurious to the men working in the galleries For these operations, therefore, powder will be retained For the removal and destruction of wrecks, rocks, and other obstacles to navigation, gun-cotton is very valuable, and for torpedo purposes, the committee follow the recommendation of the "Floating Obstruction Committee," which in 1868 pronounced in favour of gun-cotton, as the result of some extended trials Independent of its increased power, gun-cotton, when applied in the form suggested by Professor Abel, *viz*, compressed, and fired by a detonating fuze, has many advantages over gunpowder, among which its perfect safety stands prominent Gun-cotton of this construction cannot be *exploded*, unless confined in a strong case, or unless purposely fired by detonation If a light is merely set to a mass of it, it will burn gradually and harmlessly away, without any explosive effect whatever And it may be made uninflammable by the simple process of storing it damp It can be readily restored to a condition for use Gun-cotton is also cheaper than gunpowder, because, although per pound dearer, one pound of it goes as far as from four to six of gunpowder, it is also much lighter, and being weight for weight the same bulk, so much easier to carry

Gun Tackles — Two single blocks, one fixed, and the other movable, form a "gun tackle"

Gun Metal—*Vide* Bronze

Gunner—The name given to an artilleryman, obviously derived from the word "gun" one who is practically acquainted with the use of guns The duties of a gunner are very varied, and require long and careful training, with considerable experience Not only has he to be instructed in drill, and in the service of the different natures of ordnance, heavy and light, of which rifled ordnance now form a part, but he has to acquaint himself with the ammunition, the mode of using it, the care to be bestowed on it, and the several subjects which the laboratory alone can teach him, and which afford ample scope for industry Gunners should be strong, active men, not too tall This remark has reference especially to horse artillerymen The rank of a gunner corresponds with that of private in the line

Gunnery—The science of artillery theoretically and practically considered. Theoretical gunnery involves

the determination of all problems having reference to the resistance of the air to projectiles. Practical gunnery implies the actual working, laying, and firing of guns, and the carrying out of what theory teaches

It is only within the last few years that the theory of gunnery has attained its present state of perfection, enabling the artillerist, with the aid of the chronographs now in use, and from the results obtained from these beautiful instruments, to determine the most intricate questions on the flight of projectiles, either at the muzzle of the gun, which is termed the initial velocity, or the velocities at several points of the path of the same projectile The only instruments now in use which measure more than one interval of time of a shot's flight are those invented by Professor Bashforth and Captain Schultz, all others measure only the initial velocity

In our admiration of the perfection to which the theory of gunnery has now attained, we should bear in mind the fact that to Robins and Hutton we owe our earliest lessons in this science, and to Hutton the under-mentioned practical rules, which later experiments have tended to confirm —

Practical Rules

1 "The velocities generated by the action of different charges of powder in the same gun are nearly as the square roots of these charges

2 "The velocities generated by the same charge of powder upon balls of different densities will be inversely as the square roots of the weights

3 "The velocities generated by different charges of powder upon balls of different densities will be nearly in the ratio of the square roots of the charges, divided by the square roots of the weights of the balls

4 "The velocity of the ball increases with the charge to a certain point, which is peculiar to each gun, where it is greatest, and by further increasing the charge, the velocity gradually diminishes till the bore is quite full of powder

5 "The velocity continually increases as the gun is longer, though the increase of velocity is very small in respect of the increase in length, the velocities being in a ratio somewhat less than that of the square roots of the length of the bore, but somewhat greater than that of the cube roots of the length, and indeed nearly in the middle of the ratio between the two

6 "The range increases in a much less ratio than the velocity, and is nearly as the square root of the velocity, the gun and elevation being the same, little is gained in the range by a great increase in the length of the gun, the charge being the same, for the range is nearly as the fifth root of the length of the bore, an increase so small as to amount to only about one-seventh part more range for a double length of gun

7 "The time of the ball's flight is nearly as the range, the gun and elevation being the same

8 "A great difference in the velocity arises from a small degree of windage"

It will be interesting to artillerists who may not be acquainted with the opinion of the Committee of Reference on the merits of Bashforth's instrument, to know the answers to the particular questions referred to them, as contained in the following extracts from their report —

1 "Whether it is now to be considered as proved that the resistance of

the air varies practically as the cube of the velocity of the shot for all the velocities in use in gunnery, ranging from 300 to 1,900 feet per second, or for what range of velocities, and if not true, whether it is nearer the truth than any equally simple law before propounded?

Ans—"The law can only be regarded as approximately true for a limited range of velocities The resistance varies most nearly as the cube of the velocity for velocities of about 1,200 feet per second, for velocities much higher or much lower than this, the co-efficient of resistance varies considerably with the velocity

"For velocities within a limited range, the law may be regarded as giving sufficiently approximate results, provided the co-efficient of resistance corresponding to the mean velocity be employed

"This law is attended with the important practical advantage that the calculations required by it are simple, and the results to which it leads may be readily embodied in tables

2 "Whether this law of resistance is to be regarded as a new one, the discovery of which is due to Mr Bashforth?

Ans—"The law was stated by Professor Hélie in his work published in 1865, and it appears to have been in use for some years before that time in the School of Artillery of Metz, but Professor Bashforth, without being aware of this, independently deduced the same law from his own experiments, so far at least as the law can be considered true,—*viz*, for a limited range of the velocity

"Professor Bashforth by his valuable experimental determination of the co-efficient of resistance corresponding to different velocities, has furnished the data which are absolutely necessar in order to make the law applicable in practice

3 "Whether the instrument devised and perfected by Mr Bashforth for recording successive small intervals of time, is susceptible of general employment at schools of instruction in gunnery?

Ans—"Mr Bashforth's instrument is simple in principle, easy to work with, and not readily liable to get out of order, and we think it well adapted for general employment at schools of instruction in gunnery

4 "Whether any means of solving the same problem with equal precision existed before

Ans—"We do not think that any means existed before of recording a number of successive small intervals of time with the degree of precision and trustworthiness attained by Professor Bashforth's instrument"

Gunny—A coarse Indian cloth manufactured largely in Bengal It is of two kinds for artillery purposes, single and double, the former is used for charcoal bags, for package of gunpowder barrels, and as package generally, the latter for slings for carrying shot and shell, and small-arm ammunition boxes, also for covering ammunition boxes, making sand-bags, &c The saleetahs and pin-bags for tents are also made of gunny The material from which this article is manufactured is the fibre of two plants of the genus *Corchorus*, i e, *Corchorus olitarius*, and *Corchorus capsularis*, both, but particularly the first-named plant, are extensively cultivated throughout Lower Bengal It is universally used for bags of all sorts, and there is a very large exportation of this cloth to America, the Coromandel and Malabar Coasts, and Singapore

Gunpowder — The motive or propelling force of projectiles from ordnance, which, on being inflamed, generates an elastic force capable of throwing shot and shell to enormous distances Gunpowder appears to have been known from a very early date, and first, in all probability, to the Chinese, as far back as two thousand years, and it is not unreasonable to suppose so, for both in China and India saltpetre abounds, the value of which in connection with charcoal, if not as a propelling power, was taken advantage of to form the mysterious fires spoken of in their works Fireworks seem to have been largely and commonly used, and also rockets, but, for artillery purposes, the value of gunpowder seems not to have been realized in either of these countries till a very late date in India, not until about the reign of Akbar, when the art of gun-making was received from Europe In Europe, gunpowder was unknown till about the year 1320, and the discovery is attributed to a German monk named Schwartz, though there is reason to believe that our countryman, Roger Bacon, knew of it a century earlier, however, little advantage appears to have been taken of it till the 15th century, when great strides in gunnery were made, especially in France

Gunpowder is formed from the intimate mixture of three ingredients, saltpetre or nitre, charcoal, and sulphur, in the proportion, as made in the present day in English factories, of 76, 15, 10 Saltpetre, before being mixed with the other ingredients, should be perfectly refined and free from all impurities, especially deliquescent salts, such as chloride of sodium Charcoal should be made as it is wanted, and used soon after, from its liability to imbibe moisture if kept any time in store, but except for this reason, there appears to be nothing against its being used for gunpowder purposes at any time, as long as the analysis shows it to possess the properties of a good charcoal, when all that is necessary in weighing out the charges is to make an allowance for the moisture, by adding an equivalent in charcoal Good charcoal should burn without having any residue, it should be light, sonorous, and easily pulverised, and when broken should have a velvet-like appearance, further, it should be soft and friable,—so soft as not to scratch polished copper, and ought not to exhibit any alkali when treated with pure distilled water The sulphur should be as pure as possible, and, to obtain it so, should be fused or treated by distillation The three ingredients having been brought together, are first mixed in a mixing machine, then transferred to the incorporating house, where they undergo, from the peculiar motion of the machinery, a grinding, twisting, and a mixing action, until formed into what is termed "mill cake," from thence the powder, in this state, is taken to the "breaking down house," in order that the cake may be broken into a convenient size, before being taken to the press house, where it is subjected to hydraulic pressure,—*viz*, about 70 tons to the square foot for R L G, L G, and F G, and 50 tons for R F G—it is then transferred to the granulating house, to be there formed into the several sized grains required, either for gun, musket, or rifle powder, it is also dusted in this house After this process, the powder has to be taken to the dusting and glazing house, to free it still further from the small particles of dust remaining amongst the grains, this being completed, it is glazed, then dried, and lastly dusted again, before being

examined, proved, and barrelled-up This then is the whole process in the manufacture of gunpowder, which is more closely given in detail under the several heads of manufacture

The great object to attain in making gunpowder is to produce equal results from equal quantities of the manufacture, but this, for various causes, cannot be relied on, hence the unequal practice observed with the same charges and from the same piece The density of R L G powder should not be less than 1 68, and not more than 1 75, and R F G 1 55 to 1 65 The part that each of the ingredients performs in the inflammation of gunpowder is thus explained in Abel and Bloxam's Hand-book of Chemistry "The action of this substance as a propelling agent is dependent upon the rapid oxidation of the charcoal by the nitre, and the consequent sudden evolution of a large volume of heated gas In a mixture of nitre and charcoal alone, the oxidation (deflagration) proceeds with comparative tardiness, the addition of sulphur greatly augments the combustibility of the mixture (in consequence of the lower temperature at which it ignites) the sulphur by its presence also renders available for the oxidation of the carbon an extra amount of oxygen,—namely, that which is united with the potassium, the latter being at once converted into sulphide upon ignition of the powder The temperature at which gunpowder ignites is about 600° For the explosive effects of gunpowder, the reader is referred to Colonel Boxer's Treatise on Artillery

To separate the three ingredients of which gunpowder is formed, the following method should be pursued —

First, for Moisture

Weigh accurately in a watch glass 50 grains of gunpowder, and place the same in the *water-oven*, which should not exceed 150° in temperature, until perfectly dry (say about an hour) Then remove it, and place it in the scales, the difference of weight in its cold and hot state will be the moisture required Deduct 01 of a grain for the difference of temperature of the glass between its cold state, and the degree of heat in it when it again reaches the scales, which between the oven and the scales will, to a certain extent, be lower than that of the gunpowder Multiply by 2 for the percentage to make up 100 grains

Second, to extract the Saltpetre

Weigh as before 50 grains of gunpowder, and place the same in a glass beaker, mixing it with hot water, which place on the water-oven for about an hour Decant the same in a *known* filter placed in a glass funnel, and frequently wash the filter with the *wash bottle*, so that no trace of saltpetre be left in it Take the filtrate, which now contains a solution of saltpetre, and evaporate it over the oven When evaporated, weigh the result, which, multiplied by 2, should give nearly the original quantity of saltpetre with which the gunpowder was made

Third, to ascertain the weight of Sulphur and Charcoal together

Weigh, after the saltpetre has been extracted, the sulphur and charcoal left in the filter This is effected by placing the filter with its contents on the oven to dry, and afterwards enclosing it in a glass tube corked down, the weight of the tube, cork, and empty filter in their cold state having been previously ascertained Deduct then the weight of the tube, cork, and empty filter from the weight of the tube, cork, and filter with its contents, and the difference

will be the weight of the charcoal and sulphur

Fourth, to extract the sulphur

Take 20 grains of gunpowder, 20 grains of pure saltpetre, 20 grains of carbonate of soda, and 80 grains of chloride of sodium (common salt) Mix these all together in a crucible, and place the same on a charcoal fire, until the mass becomes perfectly white, then remove it, and put it with the crucible into a beaker of cold water Place the beaker on the *water oven* until the mass dissolves, then filter The filtrate is now heated, and acidulated by hydrochloric acid until all effervescence subsides Then pour in a few drops of chloride of barium, from time to time, which will cause the sulphur in the solution to be precipitated The solution in the beaker is now passed through a filter, and the contents of the filter (which is now sulphur alone) dried and weighed, and deducted from the sum of the charcoal and sulphur previously thus computed leaves the charcoal required A more efficacious mode of extracting the sulphur is with bi-sulphide of carbon

The sum of the three ingredients, with the moisture, should make up 99 86 of 100 grains, the slight difference being supposed to have escaped during the process of separation, in the form of nitric and sulphuric acid gases

Gutta Percha—As explained in Balfour's Cyclopædia of India, is the concrete juice of a forest tree, a native of the shores of the Straits of Malacca, Borneo, and the neighbouring countries The tree is from sixty to seventy feet high, and three or four feet in diameter Boiling appears necessary when the juice is collected in large quantities, but when a small quantity is allowed to exude from a freshly-wounded tree, and is collected and moulded by the hand, it consolidates perfectly in a few minutes, and has all the appearance of the prepared article Gutta percha, when quite pure, is grayish white, but it is generally brought to market of a reddish brown hue The great peculiarity which makes gutta percha convenient and valuable for a variety of purposes is, that when plunged into boiling water, it becomes so soft and plastic as to be easily moulded into any desired form, and this form it permanently retains on cooling It is used in the artillery service to take impressions of the bore of a piece of ordnance which exhibits flaws or cracks after firing

Guy Ropes—Are used as steadying ropes to the heads of spars, sheers, derricks, gyns, &c

Gymnastics—The art or method of exercising the body to make it active, supple, and capable of bearing much fatigue It comprises athletic exercises, fencing, broadsword and bayonet exercise, and now forms part of the instruction given in setting up the British soldier

Gyration, Centre of — Is that point of a system of bodies round an axis, in which, if all the matter of the system were collected, the same moving force would produce the same angular velocity in the system

H.

Hackery—An Indian cart, used generally in the Bengal Presidency for the carriage of country produce, and in the transport of Government stores

Hair-cloths—Made of horse hair, 15 feet by 12 feet in size They are placed upon the floors and tables of magazines, or buildings in which powder is stored or handled, to pre-

vent accidents from grit They are also laid down on a jetty to roll powder barrels on, or to cover powder barrels in transit, for which purpose they are better suited than for any other

Halberd or Halbert—A weapon formerly used by the serjeants of Infantry and Artillery, and so late as the beginning of this century, it was in use in the army Its shape is that of a spear, with a shaft about 5 feet long, the head of which was mounted with a steel point Besides this it had a cross piece of iron attached to it, which enabled the halberdier to cut as well as thrust It is said to have been originally used by the Danes

Another use the halbert was put to, —*viz*, when soldiers were flogged Several were heaped together, and the soldier was lashed to them, hence the saying, "I'll send you to the halberts"

Hale's Rockets—*Vide* Rockets, Hale's

Half Battery—In artillery, a portion of a Field Battery, consisting of three guns, with their wagons

Half-wrought Materials—In artillery, consist of the several parts of gun carriages in the rough, or partly shaped to the form required Supplies of these materials are kept in every arsenal, and are issued to batteries on indent Each battery in the field is allowed the following half-wroughts —

Beam	1
Cheeks	2
Perch Wagon	1
Splinter Bar	2
Shafts, spare	2, complete
Felloes	12
Spokes	24

But as a spare carriage is allowed, there is no necessity to carry such ponderous articles as beams, &c, the officer commanding a troop or battery will, therefore, use his discretion, according to the nature of the service on which he may be going, as to what half-wrought materials he will carry, any in excess of the number allowed being provided at his own expense On leaving a station where there may be an arsenal, he can, if he thinks fit, return into store such half-wroughts as he may not wish to carry on the march, receiving from the ordnance officer a receipt, which will be his voucher for obtaining others free of charge at the next arsenal

As the new Indian field carriage is made of iron, the supply of half-wroughts will be reduced

Halt—A term well known to soldiers It is the word of command given to a body of men on the drill ground, or to a regiment or an army on the march, to discontinue their forward progress

In the march of a body of soldiers, halts are very necessary for the comfort of the men, and to enable them to rest themselves On the usual daily march of a regiment in India, it halts half way, and coffee is served out to the men

Hames—Two pieces of iron encircling a horse's collar, connected at the bottom by an iron loop, and at the top by a strap and buckle Attached to the hames are iron lugs to which the traces are linked

Hammer—This useful tool is too well known to need description The forms of hammers are varied, and their weights estimated from tons to a fraction of an ounce

Hammer, Claw—Is used by the carpenter not only for driving home nails in light work, but for extracting them when required, which latter operation is performed by the claw of

the hammer. The claw is nothing more than the tail of the hammer split up a certain distance, so as to form two prongs, between which the nail is seized.

Hammer, Cooper's—For heading and unheading powder or ammunition barrels, and performing such coopering operations in a magazine or wherever powder is being handled, as may be required. Only copper or wooden cross-head mallets should be used for such purposes.

In heading or unheading powder barrels, the persons employed are not allowed to use the bare adze against the copper hoops, but are invariably to apply a driver.

Hammer, for Proving Shells—Is somewhat similar to that employed by tin-men. It is made use of in proving the soundness of spherical shells.

Hammer, Rivetting—Is properly a small smith's hammer, but it is also used in carpentry.

Hammer, Sledge — Used by the blacksmith when the object to be forged is not very large. The weight of a sledge-hammer is from ten to fourteen pounds, although sometimes more. The sledge-hammer is wielded by the fireman's assistant, who is termed the hammer-man.

Hammer, Steam—As described in Weale's Dictionary, "is employed instead of the old helves or lift-hammers, and is worked by a connected high-pressure steam engine, which raises the hammer to any required height within its vertical range of motion, and in which it is guided by two planed guides. On the escape of the steam, when the valve of the cylinder is opened, the hammer falls on the work that lies on the anvil with the full force due to gravity, with scarcely any loss from friction. The instant the hammer has given its blow, the steam is again let in under the piston, and the same action is repeated with ease and rapidity." This hammer is the invention of Mr. Nasmyth.

Hammer, Tilt — Used in forging implements and tools, such as shovels, spades, mattocks, and cleavers.

Hammer, Wrench, with turn-screw—Used to tighten and loosen nuts and bolts, and can, from its construction, be adjusted to any required size.

Hand—A measure of four inches, by which the height of a horse is computed.

Hand-Axe — One of the implements used by the pioneers of a regiment.

Hand-Cuff or Manacle—A fetter to secure the hands together. Hand-cuffs are made of iron, ring shaped, with a lock attached, and just large enough to keep on the wrists without hurting them.

Hand Rubbing—The manipulation which horses' legs undergo on the march, chiefly at feeding time, and which should not merely be confined to that period, but continued for 20 minutes, three times a day.

Hand-Saw—A carpenter's tool for cutting asunder wood which would be too thick to be cut by an adze, or which requires accuracy in cutting.

Hand-Spikes—Are levers of the first order. Those used in the service of artillery are of eight kinds—siege, field, traversing, iron, bevelled, handcrow, truck, and roller. Handspikes are used in raising or turning heavy stores, slinging ammunition boxes, traversing guns and mortars, and for all purposes where leverage is required to be used in artillery material.

Handles, Elevating — The projections on the top of the elevating screw of a gun, also termed "horns"

Handles, Limbering — The iron handles on each side of the trail of a gun carriage to assist in limbering up the gun to the limber

Hang Fire—Is now an almost obsolete term, on account of the improved method of discharging small-arms and ordnance The term is applied when a piece is slow in discharging itself, from the flame being checked in its passage to the charge, from the vent being fouled, or the charge being damp But the former can scarcely be the case in these days

Harness — The furniture of draught horses The origin of harness can be traced back to a very remote date, for we observe in ancient pictures, and in the description of ancient ceremonies and games, such as the Olympic games, that horses were attached to carriages with harness, of what kind and description no writings tell us, varying, undoubtedly, according to the ideas of the several nations which used it The present mode of harnessing horses to gun carriages is only of a late date The usual manner was to place one horse before the other, similar to the custom still observed in the country carts in our own land, the driver dismounted, and walking alongside his horses This, however, was found to be awkward when quick movement was required, and moreover, on the march with a long line of carriages, took up a great deal of space The idea then came to harness them two and two abreast, and ultimately to mount the horses instead of driving them on foot This now is the custom in all artilleries In the English artillery shafts are used, and to each gun carriage the number of horses is regulated according to the weight they have to pull, a team of 4 horses being able each to draw 6 cwt., or 24 cwt, a team of 6 horses, 5 cwt each, or 30 cwt, and thus decreasing rapidly in their power of draught, so that when each horse can only draw 4 cwt, no advantage is gained in employing a greater number of horses than 12 for the heaviest load in the service The harness for the off-wheel or shaft horse is somewhat different to that for the leading horses, loops or lugs having to be attached to the chaise saddle for the support of the shafts

Harness for the Indian artillery is made up in the country, and the Indian Government has established a tannery at Cawnpore, in Bengal, for the manufacture of leather and harness for that Presidency Harness is issued unblacked, and must be left so A mixture of bees' wax, mutton suet, and spirits of turpentine to be well and frequently rubbed in The whole to be hand rubbed daily

Harass—In a military sense, is the act of annoying and incessantly pursuing or hanging on the rear and flanks of a retreating force, so as, if possible, to prevent its attaining its object, and perhaps overcoming the enemy altogether Notwithstanding the disadvantage which a retreating army has under the circumstances, history affords us example, that if the retreat is conducted by an able commander, he has it in his power by his ingenuity and other military qualities to avoid his enemy by getting into inaccessible places, or by so disposing of his troops as to make it hazardous for a pursuing army to follow him up, or any longer to endeavour to harass him

Harness, Elephant—In harnessing elephants to heavy guns,

one elephant goes in the shafts, a second leads, and if a third be necessary, the animal assists by pushing from behind The following are the component parts of elephant harness

	Wheel set	*Leading set*
Back bands	1	1
Throat bands	1	1
Breast plates	1	1
Breechings	1	0
Cruppers	1	1
Girths or bands, belly	1	1
Guddeelahs, large	1	1
Guddeelahs, small	1	1
Lashings, rope	1	1
Pads for saddles	1	1
Saddles, complete, wood	1	1
Stirrups, pairs	1	1
Traces, long pairs	0	1
Traces, wheel or shaft, pairs	1	0
Chains, draft shaft, with siege carriage only	2	0

Hasp—A flat staple to catch the bolt of a lock For military purposes three kinds of hasps are used—iron, brass, and leather Iron hasps are fitted to cases for packing arms and boxes of sorts Brass hasps are fitted to gun ammunition boxes for securing the lid to the box, and leather hasps to small-arm ammunition boxes

Haversack—A canvas bag issued to every soldier on arrival in India, for the purpose, if necessary, of carrying provisions, odds and ends, &c

Havildar — A non-commissioned officer attached to a Native Regiment of Infantry, synonymous with the rank of sergeant

Hay—The forage given to horses in Europe In India, grass is daily gathered for all cavalry and artillery horses Surplus grass is sometimes stacked, and used when there is a deficiency of green grass

Head, Sponge—In artillery, the top of the sponge staff, which consists of a block termed the "head," upon which the wool to form the sponge is fastened by the process of "thrum-" ming " or wigging "

Head-Quarters — Generally understood to mean the residence of the Commander-in-Chief, whether in camp or elsewhere It is also applicable to the place where the officer commanding any independent position or body of troops resides

Head-stall — In harness, that part of the bridle which goes over the horse's head

Helix—As defined in Weale's Dictionary, any thing of a spiral form, whether in one plane, as the spiral curve, or in different planes, as the screw

Helmet—A defensive armour for the head Anciently helmets were of two kinds, an open and a closed helmet The former only covered the head, ears, and neck, leaving the face open The latter enclosed the face, besides having on the front perforations for the admission of air, and slits also to admit of the wearer being able to see, this part was styled the *visor*, which could be lifted up The helmet is still worn in certain cavalry regiments, and in India an order has been lately issued making the helmet (a cork one) the universal head dress for officers of the staff, artillery, and native army

Helve—The wooden handle of entrenching tools, such as axes, felling and pick, hatchets, kodalies, shovels, spades, also of certain artificers' tools, axes, and sledge hammers

Hemp—The fibre of certain plants grown both in Europe and India, known as the *Cannabis sativa* and *Indica*, which have been pronounced identical plants Balfour's Encyclo-

pædia gives the following description "In various notices of Indian fibres, we frequently meet with the word '*sunn*' as indicating a particular kind of hemp Sometimes we find it called Indian hemp, and we may often see hemp enumerated as one of the exports from India, at other times we may see either the same or another fibre mentioned by the name of brown hemp These various names are sometimes applied to the fibre of one or two different plants, or are employed to distinguish the fibre of three distinct plants, all of which are grown for their fibres, and have been and might be exported from India, though only two of them are now usually to be found among the exports from that country Hence, to avoid ambiguity, it is necessary to notice the plants to which these several names are correctly applicable

The true hemp (*Cannabis sativa*), *gunja* of the natives, is everywhere cultivated in the plains of India, not on account of its fibres, but for its intoxicating leaves and their secretions In the Himalayas, however, the fibre is separated for economic purposes, and was exported from India to England during the last war, and this has been the case for many years The fibre of the *sunn* or *taag* (*Crotalaria juncea*) is often called Indian hemp, but incorrectly It is the kind most generally cultivated all over India on account of its fibre, and is that usually mentioned in the exports from Calcutta under the name of hemp, but also as 'sunn' The plant may be distinguished by its flowers being of a bright yellow color, and of the form of the pea and of the laburnum, while the leaves are entire and lanceolate The fibre alluded to is very valuable for cordage, canvas, twine, &c Madras and Bombay both export large quantities of hemp"

Hero—In the present acceptation of the term, a person distinguished for acts of valour Amongst the ancients the name was accorded to men who became illustrious in war, and who were styled demi-gods, from a general notion that their actions entitled them to a place in heaven immediately after their decease

Hide-bound — Applied to a horse, signifies that his skin cannot be pulled up or raised from his ribs and back, caused from bad keep, poverty, internal disease The remedy is good grooming and diet, with gentle medicine, and keeping the animal warm

Hides—The skins of buffaloes, cows, bullocks, and other animals Buffalo hides are used for the manufacture of buff accoutrements, belting of machinery, &c , bullock or cow hides for mending cartouches and priming pouches, and a variety of other leather work For the preparation of hides, *vide* Leather

Hides, Tanned, Powder—Are used for covering the floors of powder houses and charge magazines

Highlander — According to Johnson, any person from a mountainous country Highland Regiments, though assuming the dress of Highlanders, are made up of Her Majesty's subjects from all parts of her dominions

High-pressure Engine—A non-condensing engine —*Vide* Condensing Engine

Hilt—The handle of a sword

Hinges — The joints on which doors, gates, &c , turn The usual form is that of two leaves, each furnished with a projecting segment or segments of a hollow cylinder, which fit together and admit of being united by a central pin

Hip Rafters — The rafters or

beams running diagonally from the apices of a pyramidal roof to the corners of the roof

Hitch—The name given to certain knots, known as the "timber hitch" and "clove hitch," the former of which is a valuable knot for artillery purposes, the advantage being, that as long as the strain is kept upon it, it never gives way It is a good fastening for hauling a carriage out of a difficulty and for removing large skidding

Hoist — An apparatus for raising bodies from the ground-floor of a building to a floor above, such as is used in store-houses

Hold—To be in military possession of a place

Hole—In a military sense, a hole is a pit dug by skirmishers before a fortified work to obtain cover, this is in offensive operations In defensive warfare, trap holes, with spikes or stakes termed *trous-de-loup*, are dug in rows in front of a position where the enemy is expected to attack Trous-de-loup should either be too deep or too shallow for the enemy's riflemen to take advantage of

Hole, Fuze — The perforation made in a shell for holding the fuze For the means adopted of rendering the fuze holes of rifled shells having the Moorsom gauge capable of receiving the present service fuzes, *vide* Adapter

Hole, Loop — An opening or small embrasure in military buildings for musketry fire In field works, loop-holes are made with sand bags

Holes, Blasting—In demolition of masonry works and rocks, cylindrical holes are bored and charged with powder or gun-cotton The instrument used in blasting is a borer or jumper The dimensions of holes vary, according to the purpose required, and whether powder or gun-cotton is to be used, in the latter case the depth is considerably reduced

Hollow Shot—*Vide* Shot

Holster—The leather case which holds a cavalry man's pistol Each cavalry man has two holsters attached to the front part of his saddle

Home—In gunnery, the term used to express the position of a shot when the gun is loaded Thus, "Is the shot well home?" is a common expression amongst artillerymen

Homogeneous — A term applied to various substances to denote that they consist of similar parts, or parts of the same nature and kind, thus, the substance of a solid shot may be said to be homogeneous, when the metal is of the same density and texture throughout In a perfectly homogeneous shot, the centre of figure and the centre of gravity of the mass are coincident

Hone—A whet-stone on which the finer natures of tools are sharpened after being ground on a revolving grindstone

Honey-Comb—In ordnance, the holes or cavities on the surface of the bore caused from exposure or having been much used A gun which is much honey-combed should be condemned as "unserviceable"

Honour—James in his Dictionary states that this is a term variously used in military life As a quality of the mind it cannot be too much encouraged or too much cultivated among officers of all ranks and descriptions The possession of it is a guarantee for good conduct, a bond of fidelity, and a certain barrier against military corruption Most men are excited to deeds of valour and enterprise, who would otherwise remain inactive, or only perform the mere drudgery of

service This species of honour is, in fact, the root of that *esprit-de-corps* which makes a whole body of officers tenacious of reputation, and solicitous to preserve it unsullied, from the Colonel to the lowest drummer-boy

Honours — A general term for the external marks of respect paid by troops to royalty and officers of high civil and military rank

Honours of War — This expression is more immediately applicable to the terms granted to a capitulating enemy, when evacuating a fortress No precise rules can be laid down as to the terms to be granted, as they depend on the disposition of the victorious General What is considered granting the honours of war under such circumstances, is the permission to the besieged garrison to march out under arms, with colours flying, drums beating, &c

Hoof—The hard horny substance on the feet of graminivorous animals The hoof of a horse is the seat of various diseases, to avert which requires constant attention and cleanliness *Vide* Thrush, Sandcrack

Hook—An iron crooked catch, in very general use in artillery, and distinguished by the name of the fastening to which it is attached There are also gun implements termed hooks, which are used in carrying shells which have lugs

Hook, Boat—A wooden staff having a metal spike and hook at one end It is used in pontooning and military bridging

Hooping Cartridges—Under the head of "Cartridge, Gun" it is shown that all gun cartridges are "hooped," and the necessity for it Hooping consists in making rings of worsted or braid, two, three, or even more, round the body of the cartridge, in order that it may retain its shape

Hoops—Are made of copper and iron, also of wood, and are used for casks and barrels of all sizes Copper hoops are always attached to powder barrels, and are made of thick sheet copper, 50 ounces and upwards to the square foot

Hopper—The receptacle or wooden funnel in a mill for receiving grain, &c, to be ground Hoppers are attached to most machines which have to be fed by degrees

Horizon — That line which bounds the view, and appears to separate the heavens from the earth The horizon is distinguished into the "sensible" and the "real" The sensible horizon is the circular line which limits the view, the real is that which would bound it if it could include the hemisphere

Horizon, Artificial—Is thus defined in Brande and Cox's Dictionary "The plane of the horizon is a tangent to the curvature of the earth at any place, and is assumed very nearly by the surface of a quiescent liquid, which thus becomes an artificial horizon, from which the altitude of a heavenly body, for instance, may be measured" The usual mode of forming an artificial horizon is by a bath of mercury, placed under a two-sided glazed cover

Horizontal—Parallel to the horizon, perpendicular to the plumb line

Hornbeam—The *Carpinus betulus* of botanists The wood is white, hard, and heavy, and is used for the cogs of wheels in machinery

Horn-Work—In fortification, a work thrown out beyond the glacis before a bastion, and having one front Horn-works having more than one front

and placed before ravelins, are called crowned works, their long branches or wings are in every case directed so as to be flanked by the fire of some of the main works

Horns—The handles of the elevating screw of a piece of ordnance

Hors-de-Combat—A French military phrase, signifying that an individual, or body of men, are so completely disabled in fight, as to be unable to maintain the field of battle

Horse—This noble animal forms the draught for artillery in most parts of the world, except for heavy ordnance in India, where elephants and bullocks are used Less than a quarter of a century ago, bullocks were extensively the draught in India, except for Horse Artillery, the change to horses has added very much to the efficiency of Field Artillery The horses used in India for draught purposes are, to a large extent, born and bred in the country, some from English sires by country dams others of a pure country breed, the latter, as colts, are offered for sale to the Government Stud Establishment, and such as are selected by the Superintendent are reared in the stud They grow in height from 15 to 16 hands, and are found to be strong, hardy, and equal to carrying between 18 and 20 stone Those for draught purposes were, up to a very late period, "entire," but geldings have been found equally efficient, less impetuous, and more docile and tractable Besides stud horses, Government have, from time to time, imported largely into the Service horses from Australia, which have been found, from their size and strength, to make admirable draught cattle, but do not stand the climate so well as the "stud-bred," being subject to liver complaint if exposed during the hot winds, moreover, they have not the speed of the "stud-bred" In the Bombay Presidency, Arab horses are very generally used for draught, also Gulf Arab horses, but the former want height, they are, however, more hardy, docile, and willing than either the "stud-bred" or Australian

Horse Artillery—Forms the most movable branch of the artillery service On account of its lightness and mobility it acts with cavalry, the gunners are all mounted on horseback in detachments accompanying each gun The present equipment of the horse artillery is composed of 9-Pr Armstrong guns, but which are to be changed for 9-Pr muzzle-loading rifled guns either of bronze or steel

Horse Guards — The present official residence of the Commander-in-Chief of the British Army It is situated in Parliament Street, London It contains the offices of all the Head Quarter staff of the Army James in his Dictionary states, that the term Horse Guards was given to the building from a guard having been originally mounted there by the Horse Guards

Horse Holder—One of the gunners forming the mounted detachment of a horse artillery gun, who, on the gun going into action, does not dismount, but holds his comrade's dismounted horse

Horse Power—By this term, as introduced by Watt, and as explained in Burn on the Steam Engine, is meant the mechanical force necessary to lift 33,000 lbs 1 foot high per minute Engines now, however, calculated at this rate, really exert a greater power than the nominal power, it is, therefore, of importance to be able to calculate the effective or actual horse power of an engine, without reference

to its nominal power This is ascertained by means of the "indicator," which gives the effective pressure on the cylinder of the engine, from this is deducted a pound and a half of pressure absorbed in friction, &c, the velocity of the motion of the friction in feet per minute is calculated by multiplying the number of revolutions of the engine per minute by the length of stroke These data having been ascertained, the following rule will give the "effective" power of the engine, calculated on Watt's data "Multiply the area of the piston in square inches by the effective pressure (found as above), and by the motion of the piston in feet per minute, and divide this by 33,000, the quotient is the actual number of horse power For each horse power of an engine, it is calculated that 33 cubic feet of steam is expended per minute, or an evaporation of 1 cubic foot per hour The combustion of 1 lb of coal is calculated to raise 6 or 8 lbs of water into steam Land engines are generally calculated to consume 10 lbs of fuel per hour for every nominal horse power, or 5 or 6 lbs for each actual horse power"

Horse Shoes—Are forged from rods of bar iron of about an inch and a quarter in width, and three-quarters of an inch in thickness The weight of a shoe varies from 12 to 20 ounces, and the width and thickness vary with the strength and age of the horse, the purpose for which he is employed, whether for draught, riding, &c

Horsley Powder—An explosive agent which has been used in charging torpedoes It is a compound of chlorate of potassa and gall-nuts, in proportion by weight of three to one

Its disruptive action in relation to the best gunpowder, volume for volume, is something like 15 to 1

Hose, Powder—Is formed by sewing together the two edges of a tape, ¾ inch wide, along its whole length, and filling it with gunpowder When used, it is enclosed in a trough made of two battens of wood, or in a bamboo For the length of hoses, *vide* Mining

Hospital—A place of reception for the sick, when under medical treatment In India, military hospitals are built for the sick of each regiment in every cantonment On service, hospitals are erected in every camp, tents being provided for the purpose In the vicinity of towns or villages where warlike operations are being carried on, any available buildings under protection are made use of as hospitals In the war between the French and Prussians, hospitals were formed in many of the captured French towns, churches, railway stations, and other public buildings being made available Of fixed military hospitals in England, Netley is one of the finest and best organized

Hospital Wagon—*Vide* Ambulance

Hostage—A person given up to an enemy as a pledge or security for the performance of the articles of a treaty

Hot Shot — Properly termed red hot shot, were tried as early as the 16th century, but this incendiary missile may now, in a great measure, be said to be superseded by Martin's shell

The instructions for heating shot are as follows

They are not to be brought to a white heat, as they become brittle and break into pieces on striking a hard substance, after being heated, they

must be gauged, as they expand in this process, and do not return to their original dimensions on cooling To load with hot shot, the charge, which is never to exceed $\frac{3}{4}$ of the ordinary service charge ($\frac{1}{5}$ to $\frac{1}{6}$ will be found sufficient), is placed in a sound seige bag, and carefully sent home, then, a very tight dry wad is rammed over the charge, over this a high wet junk wad (though this is not necessary if the gun is to be fired at once) The gun has a small elevation given it that the shot may roll home

Hour Glass—A glass vessel filled with sand, and compressed and attenuated at its centre into the shape of the figure 8, so that the sand can only run through the connecting orifice in a given time This vessel is contained in a wooden stand Each regiment is furnished with an hour glass Native guards and regiments in India formerly made use of a metal bowl with a small hole in the bottom of it, which was allowed to swim on the surface of water, and to fill in the space of an hour This rough and ready mode of ascertaining time, though not always correct, gave a near approximation to the lapse of an hour

House, Defence of a—Warfare affords many instances when it has been necessary to defend ordinary dwelling houses, the most approved method of doing so is as follows "The doors, windows, &c, should be blocked up with sand bags, except such as must be left open for communication The latter should, if possible, be strongly closed with massive doors, loop holes should be pierced when necessary, and if there are no projecting wings or porches to supply flanking defence, tambours or stockades should be thrown out for that purpose. If it is necessary to afford increased obstacles, a ditch may be dug round the house Flat-roofed buildings are found sometimes strong enough to bear light artillery, ruined houses, if they have strong walls, can be converted into cavalier batteries by filling them up with rubbish and earth"

Housing—The trappings of a horse A term nearly obsolete

Howitzer—A piece of ordnance for throwing shells Howitzers are shorter, lighter, and have less metal in them than smooth-bore guns of the same calibre, but are mounted in a similar manner, having the trunnions placed in the axis of the piece instead of under it Howitzers have, besides, a chamber for the reception of the charge, either cylindrical or gomer shape, the former may be regarded as obsolete, all howitzers being now cast with chambers in the latter form The advantage derived from this shaped chamber is the concentration of the charge, whereby the shell fits close into the chamber, and little or no windage being left, the projectile receives the whole of the explosive force of the powder The Dutch appear to have first introduced howitzers, according to General Cotty, and the French first cast them at Douay in 1749 In appearance, a howitzer is very similar to a gun, having the same rings and mouldings, but being adapted specially for shell firing, its use is differently applied Major Owen states in his Lectures on Artillery "Howitzers were originally introduced for the purpose of firing shells at low angles, and have constantly been found most useful both in field and siege operations, during the wars of the last and present centuries Since the introduction of shell guns their

utility has greatly decreased, for the shell gun possesses greater accuracy and range than the howitzer, these qualities being, in the present day, of greater importance than small weight" Siege howitzers are denominated according to the size of their bores in inches, field howitzers according to the weight of the shell they throw The ammunition used with howitzers consists of common and shrapnel shell, case shot, and carcass It is proposed to introduce into the service rifled howitzers, which will probably supersede the present smooth-bore pieces of that nature

Hurdles—Constructed in nearly the same manner as gabions, except that the pickets are placed in a straight line instead of a circle Hurdles are three feet high, and two feet broad, and are found very useful, during sieges they serve as a cover for the protection of the workmen in the trenches

Hurter—A piece of timber eight inches square, and about eight feet long, placed at the head of the platform, next to the interior slope of the parapet This beam prevents the wheels of the gun carriages from injuring this slope of the parapet, and is also useful for night firing, as marks can be made upon the hurter from observations of the enemy's position taken during the day, by means of which the guns are preserved in nearly the same direction There are, however, better means, now, than this of directing the fire of guns by night—*Vide* Collimator

Hussars — The national cavalry of Hungary Most of the continental nations have introduced this species of light horse into their armies In the British army there are thirteen regiments The men are armed with a sabre, carbine, and pistol In the Hungarian army they are looked upon as irregular troops, and great feats of valour and activity are attributed to them

Hydraulic Press—A machine adapted for giving great pressure in cases where little motion is required The action of this press is founded upon the fundamental principle in hydrostatics, that "when a liquid mass is in equilibrium under the action of forces of any kind, every molecule, or part of the mass, sustains an equal pressure in all directions" (*Vide* Weale's Series) "Hydrostatic presses consist essentially of two distinct parts, *viz*, the *press* or machine, in which the force acquired is applied, and the pumping 'apparatus' by which the water is forced into the press, these two parts of the entire machine being connected only by the pipe through which the water passes from one to the other" (*Vide* Baker's Mechanics) All gunpowder factories have hydraulic presses attached to them for pressing the powder

Hydrogen—A colourless gas, permanently elastic, without taste, and when perfectly pure, without smell It can be procured as follows Take a small iron tube, such as an old gun barrel, and partly fill it with iron filings, place it across a fire, so that its middle portion shall be red hot, on sending vapor of water through it from a small boiler, a gas will issue from the other end, which, on the application of a light, will take fire and burn with a pale yellow flame This is *hydrogen* In this beautiful experiment, water, which is a compound of hydrogen with oxygen, is decomposed, the oxygen is kept back by the iron, and enters into combination with it, producing oxide of iron The hydrogen not having the power of combin-

ing with iron, is set free and escapes Hydrogen is the lightest substance known, hence its use in filling air balloons Hydrogen has no smell when quite pure, and is not poisonous, it cannot, however, support life Oxygen is, bulk for bulk, exactly sixteen times heavier than hydrogen, the relative weights, therefore, of any measure of oxygen and two of hydrogen, must be as the numbers 16 to 2, or 8 to 1

Hydrometer — An instrument for determining the specific gravities of liquids, and also the strength of spirituous liquors It consists of a hollow ball of glass or metal, with a weight below it, and a slender graduated stem above, so adjusted as to float at a particular mark in pure water When immersed in a lighter liquid, such as spirit, the lateral pressure of the fluid particles which support it being diminished, the bulb sinks, till a portion of the stem becoming immersed, its weight is decreased, and the balance again restored The instrument may be adjusted to different liquids by movable weights, while the graduations of the scale are made to express the specific gravities by the degree to which it sinks There are several kinds of hydrometers, but Sykes's is most commonly used

Hydrostatics — The science which treats of the mechanical properties of fluids, strictly speaking, the weight and equilibrium of fluids The weight and equilibrium of fluids at rest, are the objects of this science When the equilibrium is destroyed, motion ensues, and the science which considers the laws of fluids in motion, is hydraulics

Hygrometer — An instrument for ascertaining the quantity of moisture held in the atmosphere This is effected by observing the temperature of the air, and the dew point, or temperature at which condensation of aqueous vapour first takes place These points being ascertained, the elasticity and density of the aqueous vapour, its weight in a cubic foot of air, its degree of dryness, and rate of evaporation, may be ascertained from tables prepared for the purpose

I.

Ice—Congealed water or other fluid For the transport of Light Artillery across ice, the ice should not be less than 6 inches in thickness For Heavy Artillery, 8 inches, the entire weight of the system being so distributed, that each square foot (in contact with the bottoms of the runners) shall not experience a pressure of more than about 1,115 lbs To strengthen ice, place a layer of straw over it, throwing water upon it, allowing that to freeze, then another layer of straw and again water

The penetration of shot into snow or ice may be taken as follows, the 24-Pr and 18-Pr a mean depth of 15 feet into snow, into ice, 8 feet, the 9-Pr, 11 feet into snow

Ichnography—In drawing, the ground plan of any work or building

Impact—Is the blow with which a body in motion impinges upon another either at rest or in motion, the moment of impact being that when the bodies meet Of the pressure the two bodies will exert on each other, we neither know the amounts nor the time during which they act, but as Colonel Boxer, in his Treatise on Artillery, remarks, "The third law of motion will enable us to determine the relation existing between the momenta of the bodies before and after impact, for it follows from this law that whatever

momentum is gained by one body during the impact is lost by the other, so that, provided no other impulse has acted upon the bodies at the same time, the sum of the momenta remains unaltered If, then, a body of small mass impinge with great velocity upon a body of much larger mass at rest, and the two bodies after impact move on together with a velocity which, from the nature of the motion, can readily be measured, the masses of the bodies being ascertained, the whole momentum of the two bodies after impact is known, and this being also the momentum of the smaller body before impact, the velocity with which it struck the larger body is immediately known Suppose, for instance, that a cannon ball weighing 24 lbs strikes a block of wood weighing 1,976lbs, from which it will not rebound, so that after the stroke the two may move on together with one common velocity of twenty-four feet per second, the block of wood being perfectly free to move, then, the momenta before and after impact being the same, if v represent the velocity of the ball before impact—

$$24 \times v = (1976+24)\ 24$$
$$\text{or } 24\ v = \quad 24 \times 2000$$
$$v = \frac{(24 \times 2000)}{24} = 2000 \text{ ft}$$

and the velocity with which the ball strikes the block, is determined from the measured or computed velocity of twenty-four feet of the block and ball together after the impact"

Impetus — Momentum, violent tendency to any point, strictly, a force proportional to the mass and the square of its velocity conjointly

Implements — Those used in the Artillery Service and for small-arm purposes will be found in the "Equipment of Artillery" compiled by Major Miller, R A, V C., forming Part II of Army Equipment, and in Majendie's Treatise on Ammunition They are too numerous to be detailed in a work of this nature

Impregnable — Any work or fortress which resists the repeated assaults of an enemy, is said to be "impregnable"

Improved Shrapnel—*Vide* Shell

Incandescent—White or glowing with heat

Incendiary Shells—Comprise the following, Martin's shells and carcasses

Inch—A measure of length, the twelfth part of a foot An inch is the smallest lineal measure to which a name is given It is, however, divided by mechanics into eighths, and by surveyors and others into tenths and hundredths The inch was formerly divided into three parts called barleycorns, and also into twelve parts called lines, neither of which denominations is now in common use

Inclined Plane—In mechanics, is a plane which makes with the horizontal plane any angle whatever, forming one of the simplest mechanical powers The inclination of the plane is measured by the angle formed by two lines drawn from the sloping and the horizontal plane, perpendicular to their common intersection The following is the mathematical formula for it P=W sin a, when A = angle of plane, and parts parallel to the plane The pressure on the plane = W cos a

Incorporation—That process in the manufacture of gunpowder by which the ingredients receive the three-fold action of crushing, grinding, and mixing The process of incorporation forms a very important part in the manufacture of gun-

powder, and any failure in this stage cannot be made good by any subsequent process The incorporation of the ingredients is performed by the application of large iron cylindrical rollers, from 5 to 7 feet in diameter, and from 14 to 18 inches in width, each weighing 4½ tons, revolving in an iron circular flat bed, about 7 feet in diameter, fixed very firmly in the floor of the building, and in which the ingredients (previously mixed) are placed, being spread evenly over the bed, and moistened with 4 to 6 pints of distilled water, the rollers are then put into motion by steam or water power, and make 8 revolutions per minute during the time the charge is being incorporated, which for R L G powder is 2½ hours, and for R F G 4 hours At the expiration of each of these periods, the mill cake (the name it now assumes), which is in lumps of a quarter to half inch thick, and of a blackish gray colour, is removed to the charge magazine until required to be "broken down"

Increasing Spiral — A term applied to the twist or the spiral inclination of the grooves of rifled arms, which increases towards the muzzle, and is hence called a "gaining twist" The advantages of this kind of twist in small arms are supposed to be, greater accuracy of practice and less recoil than in other muskets (*Vide* Gaining Twist)

Increment — The quantity by which anything increases or becomes greater Used chiefly in relation to mathematics

Indemnification—Compensation for injuries committed by one nation against another.

Indent—A form of requisition used when stores are required To obtain military stores in India, either for the first time, or to replace those condemned, an indent must be drawn out by the indenting officer, who, in the case of requiring stores to replace others condemned, must attach to his indent a copy of the Board's Survey Report, showing the date when, and source whence, the condemned articles were received, also a voucher that the stores have been condemned In the case of any that have not served the full period laid down in the regulations, information as to the reason is to be furnished In all other cases, the cause of deficiency must be clearly explained If the indent be for articles lost or injured, and if the value be above 20 rupees, proceedings of a Court of Inquiry are required to accompany the indent, in which it should be stated whether blame attaches to any party, and if so, to whom When the value is less than 20 rupees, a certificate to the same effect, signed by the officer commanding, is to be furnished, indents will not be passed unless the above rules are complied with Indents for ordnance stores of different natures are to be submitted yearly and half-yearly,—*vide* G O No 358, 12th December 1870 Indents for stores urgently required can be obtained, but emergent indents should be resorted to only in extreme cases, as the Regulations provide that indents for stores shall be made out periodically, which should comprise the wants of the regiment or battery in lieu of those annually surveyed and condemned Condemned stores should be sent, when opportunity offers, to the nearest arsenal, where they will be disposed of, but should the arsenal be far distant and the transit creative of expense, the stores may be sold by auction on the spot, with the sanction of the

Inspector-General of Ordnance, the proceeds to be remitted to the nearest treasury, and an account sale forwarded to the Auditor of Ordnance Accounts There are certain stores of which the Government of India do not allow the sale, such as gunpowder, ordnance, small arms, percussion caps, and all combustible stores Gunpowder, when condemned, is used for the morning and evening gun, or if unfit for this purpose, the saltpetre is extracted from it, guns, if made of gun metal, are sent to the foundry and remelted, small arms are broken up, the barrels in two pieces, percussion caps are immersed in water, the composition cleaned out, and the cap flattened, the copper being sold and credited to Government, and combustible stores, after the composition has been soaked in water and removed, are broken up

Indian Rifled Gun — This gun is a muzzle-loader, made of bronze, and lately sanctioned for the Indian Service for Horse Artillery and Light Field Batteries, in supersession of the Armstrong gun This change in the light ordnance of the Indian Service has been brought about from experience having shown certain defects in the working and preservation of the Armstrong gun, which renders it unsuitable to the country Further, as it is a gun which cannot be made in the Government foundry in India, it was considered objectionable to be dependent on England for the supply of ordnance

With these and other objections fully realised by the Government of India, the subject was referred to the War and India Offices, and subsequently a special committee of artillery officers was appointed in England in 1868, of which Colonel Maxwell, the Superintendent of the Indian Foundry, was a member, with the view of testing the value of muzzle-loading rifled bronze guns After a series of experiments, the committee proposed the present gun, which appears to combine all the shooting qualities of the breech loader with none of its defects The endurance of the proposed gun, as proved by the committee, was undeniable, as it stood over 2,500 rounds and from the description of the gun in a paper read by Colonel Maxwell at the Royal United Service Institution in March 1870, whose modification of the grooving of the gun has added greatly to its shooting qualities, it appears to be as near perfection as a light field gun can be The present gun which is a 9-Pr of 8 cwt, though sanctioned for Horse Artillery and Light Field Batteries, is to be changed, as regards the latter, for a heavier gun, 16-Pr This change has, doubtless been brought about from the great superiority of the Prussian gun (15-Pr) over the French 9-Pr in the campaign of 1870 From the experiments which were carried on in October 1870 at Aldershot between the breech-loading and muzzle-loading field guns, the following changes are likely to take place The 9-Pr B L will be withdrawn altogether from the service, the 9-Pr M L will be issued to the horse artillery, the new 16-Pr field gun will be the field battery gun of the service, the 12-Pr B L being retained temporarily for field batteries, until the 16-Prs are ready, when the 12-Prs will be formed into reserve batteries for home defence

The calibre of the Indian gun 3 inches, the grooving is of the French form, slightly modified, though not in principle The length of the gun is 72 inches

The carriage is of iron, and weigh

equipped, but without the gun, 10 5 cwt, limber, filled, 14 cwt, and gun, 8 cwt, making a total weight of 32 5 cwt

There are three different projectiles used with this gun, *viz*, shrapnel, common shell, and case shot, of 9 pounds each, to be supplemented hereafter by a segment shell The charge of powder is 1lb 12 oz

Indentation — In smooth-bore ordnance, the mark caused by the bounding of the shot in the bore This phenomenon in the bore on the combustion of the charge may be thus explained The fluids produced by the combustion of the charge, and a small quantity of unconsumed powder, rush at once between the upper side of the bore and the shot, which, by virtue of its inertia, resists the movement, the current presses it upon the lower side of the bore, and causes an indentation, which increases in depth at each discharge, this cavity is called also a *lodgment*, the lodgment gives rise to a "burr," formed immediately in front of it by the displaced metal

Indicator — A self registering instrument attached to a steam engine to indicate the effective force of the piston

Indirect Firing—In gunnery, the firing at an object which is covered by a parapet, glacis, or wall, so that it cannot be seen from the battery

Inertia—The total absence of all power in a body to change its state Matter is no more inclined to rest than to motion, and were it not for external causes, such as resistance on or near the surface of the earth, a body once put in motion would continue its direction for ever

Infantry—This word is apparently derived from the Latin *infans*, signifying, as shown in Brande's Dictionary, *boy* or *servant* During the middle ages, servants went on foot while the knights rode on horseback, hence *infanteria* became the name of foot soldiers in general Among the ancient Greeks and Romans the infantry constituted the chief strength of an army, and since then, with the exception of those days of chivalry when a fictitious importance was given to cavalry, the infantry has always been considered the main strength of an army In the English army the infantry is told off into regiments of 800 strong The Army List gives the number of regiments as 109, with the Rifle Brigade and three West India regiments, and a few Colonial Corps

Initial Velocity—This term is applied to the velocity of a projectile at the moment it leaves the piece The formulæ for calculating the initial velocity of projectiles will be found in all works treating on Ballistics *Vide* Captain W H Noble's reports on Ballistic experiments

Inquiry, Court of—A board of officers (who are not sworn) assembled to inquire into the facts and circumstances of any case that may hereafter become matter of trial before a court martial

Insulation—When a body containing a quantity of free heat or electricity is surrounded by non-conductors, it is said to be insulated

Insulator—Any non-conducting substance is an insulator, among the best are—

Dry Air	Gutta Percha.
Shell Lac	Caoutchouc
Sulphur	Silk
Resins	Glass

Interior Slope—In fortification, is the inclination towards the town given to the earth forming the rampart or parapet (the base of which is made

equal to one-third of its height), in order to enable the troops to fire over it without constraint

Interval — In drill, the lateral space between men or corps In Artillery it is the space preserved between the guns, either in line or column A light field battery when mounted takes up the following space

Length of battery in line 95 yards, depth 34 yards, distance between each sub-division in line 19 yards In column of sub-divisions, a battery occupies, with 6 horses, 110 yards in depth, *viz*, 15 yards for the depth of each sub-division, and 4 yards for the intervals between each sub-division, the breadth of front 19 yards A column of divisions with ammunition wagons occupies the same ground in depth as a column of sub-divisions An open column of half batteries occupies in depth 91 yards, the interval between the half batteries being 23 yards, and between guns and wagons 4 yards The front of a battery at close intervals occupies 12 yards A battery of Horse Artillery in line occupies the same space as a light field battery

Intrench—To secure a position or body of men against the attack of an enemy, by digging a ditch or trench An army may intrench itself either by a continued or an interrupted line, in the former case, the line may be composed of parts so connected as to leave no uncovered space between them, in the latter, those parts may be isolated from each other, and uncovered intervals left between them

Intrenchment—Any work or obstacle intended to strengthen a post, or increase its defence

The method followed by the American troops in intrenching themselves after a day's march is thus described by Major H A Smyth, R A, on the capture of Richmond

"As soon as the brigade was halted in its place, without other word, perhaps, than company command, the arms were piled, and the men broke themselves into working parties to intrench Of each little squad of 12 or 15 men, a proportion betook themselves to felling trees, a second proportion to arranging them in the line of the intended parapet, a third to carrying them or other wood (especially fence rails where procurable),up to the disposal of the second, and a fourth to throwing up earth to the front of the logs with their picket shovels These latter work with all their might till out of breath, when other men relieve them at the shovelling, and so on, so that each man gets one or more turns at it before the completion of the work, and in the very light soil of Virginia a constant stream of earth is kept flying into the required place In this manner I saw a breast-work, perfectly efficient against musketry fire, thrown up along the entire front of a brigade, in forty minutes"

In future campaigns it is probable that intrenching Light Artillery will be resorted to much more frequently than hitherto

Intrepidity — As described in James' Dictionary, is an unqualified contempt of death, and indifference to fortune, as far as it regards personal safety, a fearlessness of heart, and a daring enterprise of mind According to Rochefoucault, intrepidity, especially with regard to military daring, implies *firmness* of character, great *confidence* of mind, and extraordinary strength of soul. Buoyed up and supported by these qualities (which are sometimes natural and sometimes acquired), men become supe-

rior to every emotion of alarm, and are insensible to those perturbations of the heart which the prospect of imminent danger almost always engenders

Inundation—The flooding of a portion of country with a view to its defence, by rendering it impassable to an enemy Several fortified places on the Continent are so constructed as to be able to inundate the surrounding country, and thus offer additional obstacles to an advancing enemy The means by which inundations may be effected are entirely governed by the nature of the surrounding country and the water-courses, and no specific rules thereon can be laid down

Invalids—Are either worn out or wounded soldiers, or soldiers who from permanent sickness are unable to remain in the army In the British service, disabled men are periodically invalided and sent home from India and the Colonies Besides Chelsea Hospital for the reception of worn out and wounded men, the corps of Commissionaires is open to invalid soldiers, in which every man can make his livelihood by giving his services as a messenger or watchman

Invest—To surround a place, so as to prevent all communication with the country

Investment of a Fortress—This act is synonymous with blockading a place *Vide* Blockade

Iron — The most useful metal known, and amongst the first mentioned in history From a very early period, dating as far back as the Pentateuch, we find that iron was known, though not extensively made use of at that period The value of iron is inappreciable, especially at the present day when ships are being built of it, and when such improvements are taking place in artillery Iron is found in many parts of the world, our own country, particularly in the coal districts, abounds with it, there known as "carbonate of iron," and containing small portions of manganese and earthy matter The ores found in Great Britain are always massive, and contain several impurities, which, if not extracted, affect more or less the quality of the iron These impurities are got rid of to a certain extent in the process of calcining and smelting There are three different states in which iron is produced, crude or cast iron steel, and malleable or bar iron These three modifications are the results of several and separate operations, although when each is tested separately, they are found to differ only in the quantity of carbon or charcoal in their composition Malleable iron is the purest, and has very little carbon in it, steel contains more carbon, and cast iron generally more than steel Iron is a metal of bluish gray colour, its fracture fibrous, and it is susceptible of being rolled into thin sheets When iron is subjected to a red heat, it softens and becomes tough, and its property of welding at a white heat gives a facility in working it which no other metal possesses When heated above the welding point it crumbles under the strokes of the hammer. The following description of iron and steel in the manufacture of ordnance, given by Mr Anderson, Assistant Superintendent, Royal Gun Factories, Woolwich, in a lecture at the Royal United Service Institution, in February 1862, will be found of great interest "If the value of a material were to be estimated by the place which it occupies in the world in regard to its usefulness for serving the multifarious purposes of mankind, then to the class of

metals known as iron and steel in their many modifications, must be ascribed an importance and position superior to any of the other mineral substances which have been placed at our disposal Iron, including steel, is the great staple article of Britain, and is the chief agent by means of which this country has been enabled to maintain the prominence she holds among the other nations In this country alone, above five million tons are produced annually, and the increasing applications of those materials, which we daily see going on around us in every branch of the arts of peace, as also their extensive usefulness in connection with the arts of war, render it highly necessary that every intelligent individual should have some acquaintance with the leading peculiarities of those substances, and the object of the present lecture is—

1*st* —"To point out generally the nature and the leading characteristics of those materials, and

2*nd* —"To consider their comparative fitness for one of the purposes to which they are applied as munitions of war, namely, rifled cannon

"As there is no other subject in connection with the wide range of practical mechanism engaging more attention at the present time than the one now under consideration, and which is already so well known in many of its details, it cannot be expected that much additional light will be thrown upon it in the present instance, or that any claim for originality can now be made Still it is to be hoped that the first part of the lecture may be useful to some, and that the facts which have come out under my own observation and experiments, which are referred to in the latter part, may be instructive to all

"Although iron is frequently referred to in the Old Testament Scriptures, yet we cannot find that it was extensively used until a much later period, the hindrance to its introduction probably arising from the extreme difficulty experienced in separating it from the earthy matters with which it is found in the condition of 'iron ore' The ores of iron are found extensively scattered all over the world, yet, comparatively speaking, few are now considered as fitted for the purposes of the iron-maker Questions of quality, means of effecting reduction, and other commercial questions, chiefly determine their value In Sweden and in some other countries, iron ore is found in solid rocks, forming veins in the granite of enormous thickness such ore being comparatively pure, This ore is supposed to be of volcanic origin and being generally in conjunction with igneous rocks, it, in all probability, at some remote period, was belched out from the molten matter within the globe But in this country, most of our iron is found mixed up in indurated clay or mud, in lumps or nodules, and it is supposed that these lumps are the mud of such veins of volcanic iron ore, ground down by the geological floods of an early era The lumps are generally found in beds, and frequently just above and under, and alternating with the seams of coal, by means of which they are to be smelted, and also in close proximity to the refractory material called fire clay, which is so valuable an agent in their reduction

"Previous to the smelting process, by which the iron is separated from the earthy matter, it is found necessary to subject the ore to a preliminary process of calcining, or as it is commonly termed, roasting, which is simply a subjecting of the ore to a continuous dull red heat for a considerable period, in order to drive off the foreign matters which

are injurious to the quality of the iron, and also to produce a greater degree of oxidation, as well as to open up the ore and render the smelting process more easily effected The degree of heat employed in roasting, the period of time required, and the description of kiln or oven which is used, depend entirely on the nature of the particular ore, and are found to differ in almost every locality, in all, the object is the same, namely, to keep the ore at such a temperature, and for such a length of time, as will be sufficient to expel the injurious gases, those conditions of procedure, in the great majority of cases, being derived from experience, rather than from any chemical knowledge of the changes to be effected

"Up to this stage the ore has but little resemblance to the valuable metal which it contains, and the first great step in advance is to eliminate the earthy matter and set the iron free This is effected in different ways, but the general method is to put the ore and fuel into the furnace together, then to generate an intense heat by means of a strong blast of wind, until the refractory ore is overcome and the iron begins to melt Without some other agent to assist, the process of separation would be very imperfectly accomplished, it is found necessary to employ what is termed a 'flux' This flux material is also thrown in the furnace along with the ore and fuel, and the chief object of the flux is to unite with the earthy matter and set free the iron With argillaceous or clay ore, a calcareous flux, generally limestone, is used, with a calcareous ore, an argillaceous flux is employed, or, what is better, a mixture of both descriptions of ore in due proportion Under the high temperature within the furnace, the two earthy substances assimilate and form the glassy slag or scoria, which being lighter, floats upon the liquid iron at the lower part of the furnace, and runs off by an opening left on purpose, while the iron (when a sufficient quantity is collected) is run out upon the floor into the 'pig iron' of commerce From the circumstance that the melting iron is in such intimate contact with the fuel, and from having to pass through it, like water through a filter, the quality of the iron is necessarily much affected by the nature of the fuel, and as it so happens that the presence of sulphur, phosphorus, and other impurities is found to affect the conditions of strength and other properties of the iron, those descriptions of iron that are made with the purest mineral fuel are the best, supposing other conditions to be the same, and best of all is the iron smelted with the charcoal from wood, which is obviously more free from those injurious properties which belong, more or less, to all mineral fuel used in the iron manufacture on a large scale, with which I am acquainted By subjecting mineral coal to the process of coking, it is purified to a considerable extent, still the iron which is made even with coke is not of such high quality as that made with the still purer fuel of wood charcoal

"It will thus be seen that at the very threshold of the manufacture, there are causes in operation that seriously affect both the quality and the cost, and that although in manufacture of ordnance a material of the very best description is the desideratum, still in the wide range of the Arts, there is, at the same time, a demand for every quality It thus happens, and that to a great extent, that price rather than excellence

is the predominating influence that determines the manufacture

"Iron may be divided into three great classes, these are known as cast and wrought iron, and steel Indeed, for all practical purposes, they may be looked upon as three distinct metals

"Cast iron is the material as it runs from the first process of the smelting furnace, and is that from which both wrought iron and steel are made During the smelting process, the iron has absorbed a considerable quantity of carbon, as well as retained several other ingredients and original impurities, the presence of which renders cast iron capable of being melted and re-melted a number of times, and used for the various purposes of the iron founder, and the metal is sufficiently liquid to admit of being poured into moulds of any form with the greatest facility, hence, if cast iron had the toughness or strength and the other good qualities of either of the other modifications of this metal, namely, wrought iron or steel, it would necessarily have the preference, not only on account of its cheapness, but also from the great readiness with which it can be poured into almost any variety of intricate outline, at a small expenditure of fuel, wages, or plant

"Cast iron, when considered as a material for the iron founder of general articles, is mostly affected by the proportion of carbon which is present The carbon renders the iron more liquid when in the fluid state, and softer when in the solid condition At the same time it is not quite so strong in regard to its tenacity, although possessed of more toughness than iron containing a less quantity of carbon, hence the founder is to a great extent guided in the selection of pig iron for particular articles by the quality of the compound For castings where great strength is aimed at, considerable judgment is necessary in the selection of a mixture that will secure all the conditions of softness or hardness, closeness of the grain, and that degree of toughness and strength which may be necessary There are many instances on record of cast iron having shown an amazing amount of strength, toughness, and general endurance, both in guns and in other constructions, still at the best it is uncertain, and, as will be seen hereafter, it is not strong, and is proverbially treacherous to depend upon, as it gives no warning before rupture, and hence the time has arrived when, for ordnance especially, it seems about to give place to a better material, either wrought iron or steel, or perhaps a combination of both

"The malleable, ductile, tough, and fibrous material termed 'wrought iron,' which is so extensively used by the smith for every branch of Art, is made directly from cast iron by an elimination from that compound of its carbon, sulphur, silicium, phosphorus, and other impurities, by a process of oxidation, this purification of cast iron produces a material with entirely different characteristics, it becomes much stronger, has greater toughness, is highly infusible, it loses the property of becoming liquid, and is, therefore, unfitted for the founder's purposes, at the same time, however, it acquires another property almost equally valuable, for, when brought to a high temperature, it acquires a viscous or sticky character, so that if different pieces in this condition are brought together they adhere, and if a blow is given or pressure applied, the separate pieces are made to adhere permanently This remarkable property is termed welding, and is the basis of the

art of forging as practised by the smith The conversion of cast into wrought iron is effected in different ways, although the same principle is adopted in all, namely, to burn out the silicium and carbon One arrangement is to drive off these matters by fusing with charcoal while a hot blast is playing on the liquid mass, but the more usual plan in this country is to subject the liquid to the well-known process of 'puddling' The cast iron is melted in a furnace in which a hot oxidising flame is brought to bear upon the fluid, by means of iron tools, the mass is moved and stirred and turned over in every direction so as to expose every portion of the iron in turn to the influence of the flame Under this influence it gradually loses its fluidity, and acquires the viscous or sticky property It is then parted into lumps of a size suitable for manipulation, each lump is afterwards subjected to a still further process of purification, and one which is dependent on another principle for its efficiency The lump of viscous iron may now be compared to a very dirty sponge that requires to be several times wetted and wrung in order to make it pure and clean On its removal from the puddling furnace, this lump of viscous iron matter like a dirty sponge, is put under a heavy hammer or other apparatus, the blows or squeezing of which drive off the impurities, and the mass is worked out still further by means of rollers into a long bar of coarse and dirty iron unfit for the smith, and which is afterwards cut into short pieces These pieces are piled up into a bundle, and are again put into a furnace and subjected to another heating, the iron is again brought to the welding state for another washing, and is again subjected to another beating from the steam hammer and a squeezing from the rollers, all which still further improve the purity and the quality of the iron bar

"For the production of the better descriptions of iron, this process of purification, of cutting up, re-welding, and hammering or rolling, is repeated several times, until the proper quality is attained Of course such treatment, while it improves the material, also increases the cost in a still greater proportion Even after the best treatment, the wrought iron of commerce is not chemically pure, although its combination with the grosser impurities does not seem to be of that intimate character that exists in cast iron It still contains carbon, silicium, and other matters, which fill up the minute vacant spaces between the fibres which compose the structure of the bar In consequence of the great affinity which iron has for sulphur, phosphorus, and other impurities which affect its quality, the quality of wrought iron is much dependent on the character of the fuel employed in its manufacture, the purer the coal the better is the iron, and hence that which is made with wood charcoal is necessarily the purest and best, although, at the same time, it is the most expensive The quality of the wrought iron is also greatly dependent on the original selection of the mixtures of cast iron for puddling, and on the care, skill, and close attention which are brought to bear upon all its successive stages, hence iron comes to differ as much in its qualities and properties as any two materials of the same class could be expected to be capable of doing, and more so than that of any other similar substances with which I am acquainted This difference, however, is only detected when high conditions are aimed at, and then close observation discloses

innumerable shades of quality that escape the observation of the majority of workers in iron, who use the material for purposes where the object required is easily secured

"The conversion of cast into wrought iron by the removal of carbon and silicium completely changes the characteristics of the material It has lost the brittle property, it now yields and stretches before it breaks the permanent yielding point is now higher than the former breaking point, and the breaking point is double that of the yielding point These are all strong conditions in its favor, but at the same time it has many serious defects It is difficult to produce in large masses that are perfectly sound throughout, the smith or forgeman has little control or authority over its behaviour when in the welding furnace, and hence it is extremely difficult to produce large forgings perfectly sound, even with the best treatment, there is, therefore, still great room for improvement, so as to ensure a perfectly homogeneous mass possessing all the good properties of the malleable, welding, tough material, and which, at the same time, shall be free from its numerous defects, veins, and unsoundness, yet it is but just to add, that, with all its many defects, there is no material at the present time which can be so implicitly relied upon and trusted with so much security against fracture from sudden vibration, as a piece of good sound wrought iron

"The material called steel is an intermediate compound between cast iron and the former material of wrought iron Steel is comparatively a pure iron, containing a small percentage of carbon, with some other substance in combination, which is rather obscure, and regarding which there is considerable difference of opinion This combination gives the material some very peculiar characteristics of its own, and is entirely different in character from either of the metals out of which it is made Steel can either be made from wrought iron or from cast iron The latter arrangement is the cheapest process, but the former method affords the most certain results at the present time, and that is the system chiefly resorted to in making the finer qualities of steel To make good steel of high quality, a bar of pure wrought iron is selected, mostly Swedish, which has been made with charcoal in all its previous stages The iron bars are put into a fire-brick chest along with a quantity of charcoal powder, every part of the bar being surrounded with the carbon, the air being excluded, the whole is made white hot, and kept in that condition for several days, generally about a week, according to the amount of conversion that is required During this period the pure white hot iron imbibes a new property from the charcoal into its own nature A chemical action takes place, and the wrought iron has been thus gradually turned into steel Such steel, however, is very imperfect The defects are chiefly owing to its local irregularities of conversion, for although the entire mass of the bar may have had the proper quantity of carbon put into it, yet it is found to be much improved through mixing the particles, either by welding several bars together into one bar, or even the mere working of a single bar under the hammer has the effect of equalizing and greatly improving the quality The most effectual way, however, of obtaining a thorough mixture of the particles, is to break the original steel bars into small pieces, then to melt them together in a crucible into liquid steel, and then to

mix and pour this metal into an ingot, which, when solid, is then drawn into a bar of steel of the required dimensions By this means of putting carbon into pure iron, cast steel is produced, which is the finest in quality of any of the varieties of this valuable metal But good passable steel can be made directly from cast iron, simply by not carrying the puddling process on to the full extent of wrought iron Such material is called puddled steel, and although at the present time it is not equal in quality to that which is made in the other way, still it is very much cheaper, and when more experience has been gained so as to determine the best descriptions of cast iron that are suitable for this particular process, as also the precise period when to discontinue the puddling operation so as to leave the proper quantity of carbon in the metal, there can be no doubt but that such cheap steel will be extremely valuable for many purposes, seeing that puddled steel is malleable, and has even a higher tenacity than wrought iron A very fine material is now produced extensively by breaking up the rough bars of puddled steel and melting them into a cast steel, and which, for many purposes, is found equal to ordinary cast steel as made from Swedish iron , so far as I am aware, however, it is not so good for edge tools

"Good steel can be made in a still more summary manner by means of the 'Bessemer process' The crude cast iron when in a melted state is poured into a large refractory vessel heated, and a strong blast of air is forced through the fluid, producing a violent agitation, the silicium and carbon in the iron unite with the oxygen in the air, and are driven off from the metal, until the remaining mass is almost pure wrought iron. There is then added to the iron (in order to make it steel) a definite quantity of carbon , it is introduced in the condition of liquid cast iron, of known mixture and quality , the whole is then thoroughly mixed, and the entire process is completed in about half an hour from the time of first pouring in the cast iron to the final running out of the steel into moulds or ingots By the Bessemer process large masses of steel can be made more easily than by any other method yet introduced, and apparently at less cost, and there is no doubt that in time this process will produce uniform quality

"Steel in all its combinations is a most valuable metal , in its ordinary state it is closer in structure, has greater power of resisting compression, and possesses a higher tenacity than wrought iron even of the best quality, and as such it commends itself to the engineer for the manufacture of the best class of articles, notwithstanding its greater cost, and the still greater expense which has to be incurred in its fabrication into the requisite forms But it has another property which causes it to transcend in value all other metals, namely, the capability of being tempered to any degree of hardness or softness The discovery of the fact that a piece of soft steel, when heated, and then suddenly cooled, no matter by what means, assumes a hardness approaching that of the diamond, is perhaps the most important of any in connexion with the whole range of metals, and has been of the greatest service to mankind In addition to this property of hardening, when the said hard substance is exposed to a gentle heat, it gradually begins to give a portion of its hardness, until at length it loses it altogether, and as

it so happens that at the same time that the hardness is gradually departing, a definite change of colour of the surface of the steel accompanies the softening process, this change of hue becomes a correct measure of the change in hardness, and thus the precise degree of hardness or temper that may be required for any purpose, can be attained with great certainty and uniformity Steel, wrought iron, and cast iron can all be rendered softer and less brittle by means of the annealing process, which is simply causing the materials to be made red hot, then keeping them in that state for a short time, and afterwards allowing the whole to cool down very slowly, so that every part may cool at a uniform rate, and no part or particle be under any restraint from premature withdrawal of heat, thus causing local contraction and hardness By prolonging the period of cooling, a mass of steel comparatively brittle acquires the character of toughness in a remarkable degree, and this process of annealing now plays an important part in all modern efforts to use steel either for guns or armour plates, or for anything exposed to jar or sudden vibration "

Iron Filings — Used in fireworks

Irregular Troops — Consist in the Indian army of infantry, cavalry, and artillery, they are chiefly located in the Punjab along our frontier line, but Irregular Cavalry regiments are to be found doing duty in many parts of India The irregular troops are differently organised to the regular both in pay and clothing The cavalry find their own horses, arms, clothing, and food

Isinglass — A white glutinous substance made from the sounds of certain fishes It is used in the laboratory as one of the ingredients in forming rolled stars for rockets

Isomeric — Substances which consist of the same ingredients in the same proportions, and yet differ essentially in their properties

Italian Field Gun — Is a bronze muzzle-loading gun after the French system

J

Jack, Barrel—In artillery, a machine for raising a carriage from the ground when a wheel is required to be taken off, or for any purposes in the working of gun-carriages which require leverage, it has superseded the screw-jack, and is used in siege and position batteries

Jack, Lifting—Is used for field carriages only The arm, which may be adjusted within certain limits to any required height, is a lever of the first kind, and is applied accordingly The body of the jack is the support on which it works A lifting jack is attached to each sub-division of a battery A good substitute for a jack is two handspikes placed under the axletree by two robust gunners, who will raise the carriage sufficiently to take off the wheel A new pattern jack, proposed by Col Clerk, R A, is the elevating screw of the service, in a cast-iron conical box, with metal top and triangular base This jack is of great power, and used for heavy carriages in lieu of the "tooth and pinion" and "screw jack "

Jack Tree (*Artocarpus integrifolia*)—A well-known tree in India It yields an excellent timber, at first yellow, fading to brown, hard and brittle, resembling satin, warps, if not properly seasoned A cubic foot of unseasoned wood weighs 50 lbs The fruit is very much esteemed by

the natives in the southern part of India The timber is used in the Bombay arsenals for packing cases

Jagged Spike—A particular kind of spike which is used for spiking a gun which has to be abandoned altogether

Jars, Pegu—Are made of pottery, and glazed externally They are generally of a very large size, and are used sometimes in arsenals for holding oil, &c

Javelin — A spear used by the ancients and by most nations before the introduction of fire-arms There were several sorts of javelins, made chiefly of wood, with a steel point, but there were some which had feathers attached to them, in the same manner as arrows and darts have These latter javelins were used by the Poles and other nations, but principally by the Moors, who called them zagais

Jemadar—A native officer in the Indian army, whose position corresponds with that of subaltern in a company of European infantry The name is also given to the head man of a native establishment in a factory, and indeed to any man who exercises authority over a number or gang of men

Jib—The overhanging part of a crane, or a triangular frame with a pulley at the end, for the chain which leads from the crane to pass over

Jigger Block— *Vide* Tackle

Joining—The wood-work prepared by a joiner, which is of a more delicate nature than carpenter's work

Jointer—Is a kind of plane used by the cooper in joining or preparing the sides or edges of the staves of a barrel, so that they shall fit well

Jorawallah—An Indian term A grass-cutter attached to a cavalry regiment or a horse battery, who brings in daily a double load of grass, and is paid double wages Jorawallahs keep ponies, by which means they are able to bring in double loads

Journal—A bearing of a shaft, when it is between the points where the power and resistance are applied, a bearing subject to torsion

Judge-Advocate-General —As described in Colonel Pipon's Manual of Law, is a Government functionary, resident in London, who acts as the legal adviser of the Crown in matters touching military law, the appointment is most frequently conferred upon a barrister of some standing, who is also a member of the House of Commons, he is sworn of the Privy Council, and his tenure of office is coeval with that of the administration which appoints him

To this officer, the proceedings of all general Courts-martial at home are forwarded before the execution of the sentence, in order that he may examine them to ascertain that they have been legally conducted, it then becomes his duty to submit them to Her Majesty for Her approval and confirmation, together with his opinion on any point of law, or of procedure, upon which he may think it necessary to remark

The Judge-Advocate-General is liable to serve on Courts-martial, but his duties are usually performed at home by some officer to whom he gives his deputation, and abroad, by an officer appointed to officiate by the convening authority, in both cases the acting functionary is known as the "officiating" Judge-Advocate

No general Court-martial can proceed without a Judge-Advocate, there is nothing to prevent the latter being a civilian, but the custom of the ser-

vice for a long period, has confined the office to military men

The Judge-Advocate-General of the Indian army is now appointed by the Crown, and he is assisted by officers of the army styled Judge-Advocates

Jule—An Indian term for the clothing of any beast of burden

Jumper—*Vide* Blasting

Junk—Old rope, which, being untwisted, is used sometimes in arsenals in place of oakum, to pack shot and shell, and in making wads

Junk Wads—*Vide* Wads

Jute — Is the fibre of the *Corchorus olitarious* (pot herb, or Jew's mallow) and of the *Corchorus capsularis*, herbaceous annuals which in India grow from 5 to 14 feet high The former derives its name from the leaves having been eaten as a kind of spinach The stems yield the fibre known in commerce, from which ropes, bags, &c, are made

Jyntee or Jointee (*Œschynomene Sesban*)— A wood the charcoal of which is occasionally used at the Ishapore Powder Works in the manufacture of gunpowder It is thus described by Col Anderson "The jointee grows from seed, and flowers after the first year, it then increases in size till it becomes a small tree, at three or four years old it makes the best charcoal, the fibres large and defined, and well separated, the charcoal is of a lightish colour, and is not dense to the eye or touch The tree flourishes best on the banks of small nullahs or water-courses Jointee charcoal is not so soft as that of the urhur or dhall stalk, but it is more dry, brittle, and hard An average-sized tree of three years' growth will occupy about five square yards, and produce about three maunds of wood, which will yield about thirty pounds of charcoal, the quantity required for two 100-lb barrels of gunpowder Therefore 10,000 barrels would require about sixty beegahs of land under constant cultivation, one-third to be cut each year The average specific gravity of jointee wood is 767, and sp gr of the charcoal produced from it 275, and it yields 25 per cent of charcoal"

K.

Kajawahs — An Indian term Large panniers, placed across a camel's back in which camp kettles, pots, &c, are carried on the march

Kamptulicon—A composition of India-rubber, gutta percha, and cork, which by a certain treatment is formed into floor cloths In appearance it is exactly like oil-cloth, and is susceptible of having all kinds of patterns stamped on it A kamptulicon disc is used with Boxer's shrapnel shell to cover over the bullets and rosin

Kanat—An Indian term The wall of a tent

Keep—A kind of strong tower which was built formerly in the centre of a castle or fort, to which the besieged retreated and made their last efforts of defence Of this description is the keep of Windsor Castle

Keg — Another term for a small cask or barrel In heavy field batteries, kegs are attached to hold the tar and grease for lubricating the axle-tree arms In arsenals, tar and grease are also kept in kegs

Kentledge—Old cast-iron articles which have become unserviceable, such as condemned guns, shot and shell, &c

Kettle Drums—Are large circular basins of metal, rounded at the bottom, the top being covered with vellum or goat skin They were formerly used in the artillery and cavalry,

and are still in use amongst the irregular cavalry in India

Key—In artillery, keys are of various natures, and too numerous to describe They are used for the spring locks of ammunition boxes, for shells and fuzes, for fuze hole plugs, and for Pettman's fuzes

Key-stone—In masonry, the stone in an arch which is equally distant from its springing extremities

Khalassie—An Indian sailor This race of men come chiefly from the Chittagong district Besides a sea life, khalassies take service on shore, and form a large portion of the native establishment attached to arsenals During the march of a regiment, this class of men are employed to pitch the soldiers' tents

Kicking Strap—A strap used in draught to control a violent horse One or two should be attached to each horse battery It is fastened to the shafts, and passes over the croup of the horse, thereby preventing him from kicking

Kilogramme—*Vide* Appendix

Kilt—A dress worn by men living in the highlands of Scotland and by a few regiments in the British Army It consists of a loose petticoat extending from the waist to the knees

King Post—The middle post of a roof, the foot resting in the tie beam, and the head of the post receiving the upper ends of the principals

Kink—A twist or turn in a coil of rope

Kit—A cant word among soldiers to express the complement of regimental necessaries, which they are obliged to keep in constant repair

The kits belonging to gunners and drivers of Horse Artillery, and to drivers of Field Batteries, consist of all wearing apparel pertaining to the gunner and driver, which is packed and carried in the valise Gunners of Foot Artillery carry their kit in a knapsack *Vide* Appendix

Kit—A composition of rosin, pitch, bees' wax, and tallow, in the proportion of 9, 6, 6, 1, to be melted together and poured into water, then worked with the hand until it becomes soft and pliable It was formerly used in setting the old pattern fuze, since the introduction of Boxer's fuze it is not required

Knapsack—A square case of canvas or leather, properly prepared, for strapping on an infantry soldier's back, and containing the whole of his regimental necessaries Knapsacks are also provided for artillerymen, and on the march they are carried with the baggage The etymology of the word is as follows —"knap," in Dutch, means eatable, and "knappen" to eat hence knapsack is a sack containing something to eat It is doubtful, however, whether the above is correct The author of this derivation appears to have confounded "schnappsack' (haversack) with the English knapsack In German, nouns are commonly made up of various words, so that the combination expresses the precise signification Thus, schnappsack signifies a sack into which a soldier would stuff anything in the way of eatables or drinkables which he might pick up on the march

Another derivation of knapsack is, "knapp," tight, close, compact, and "sack," a sack

Knight—As described by James in his Military Dictionary, a person who on account of some eminent service, civil or military, or no service at all, is singled out from the common class of gentlemen, &c, and is person-

ally invested with a title This word, which is originally derived from the German and Dutch *knecht* or *kneht*, signifies servant, in which sense it is applied when we speak of a knight of a shire, it likewise means a military man, or rather a horseman, from the Latin *eques*, a soldier, or horseman, knights of this description having been either the king's domestic servants, or his life-guards

For further information on the subject, *vide* Brande and Cox's Dictionary

Knots — Are ties or fastenings made with cord or rope The most useful for Artillery purposes are the timber hitch, half hitch, clove or cascable hitch, gun sling, reef knot, cat's-paw, bowline knot, sheep-shank, running bowline knot

Kodallie—An Indian term A tool used by the natives of India in digging all kinds of earth-work The face of the tool is shaped like a hoe, and has a short handle nearly parallel to the face It is used in a kneeling or sitting position

Koopah or Dubba—An Indian term A round hollow vessel with a narrow neck, to contain liquid substances, chiefly oil It is made from the buffalo's hide, the hide being cut into small pieces and placed on a mould in layers from time to time, until the thickness required is attained A small hand mallet is used to beat the hide together, which is then treated with lime, salt, and ashes

Krupp's Gun—The rifled gun used in the Prussian Service, manufactured from cast steel, after Mr Krupp's system The guns, both heavy and light are breech-loaders

Kullum (*Nauclea parviflora*)—A wood used in the Bombay Presidency for fuzes It is a light, soft, close, and even-grained wood, of a light brown colour, not very durable, and will rot when exposed to wet

Kunkur — An Indian term, a limestone deposited from water It is very common in India, and used in many parts of the country (wherever it can be found) for metalling roads, and in the preparation of lime It is also known under the name of *ghooting*

Kyanising — *Vide* Corrosive Sublimate

L.

Laboratory—A department of an arsenal for the manufacture of ammunition and combustible stores A laboratory should be divided off into the following rooms

A compressing room, for the lead used in the manufacture of bullets, and for the formation of the bullets themselves

2nd—A room for heating composition

3rd—Cartridge rooms, for gun and small-arm cartridges

4th—Composition rooms, for mixing compositions

5th—Driving rooms, for driving rockets, port-fires, fuzes, &c

6th—Packing rooms, for putting up ammunition

7th—Rooms for the manufacture of friction tubes

8th—A room or rooms for the manufacture of fulminate of mercury and percussion caps

These rooms can be arranged either in separate buildings or under one roof, if in separate buildings they should be connected by covered passages, further, they should be apart from any inhabited buildings The following precautions against accidents should be taken Avoid as much as possible the use of iron in the construction of

the buildings, fixtures, tables, &c, of the laboratory, sink the head of iron nails if used, and paste paper or putty over them, better still, a plug of wood The use of copper screws or nails is a still better arrangement The floor should be of wood, and where powder is manipulated, covered with leather, and frequently swept Keep no more than the requisite quantity of gunpowder in the laboratory, and have the ammunition and finished work taken to the magazine Let powder barrels be carried in hand barrows made with leather or canvas, and the ammunition in boxes Let every thing that is to be moved be lifted and not dragged or rolled on the floor, except on the chime of the barrel Never drive rockets, port-fires, &c, in a room where there is any powder or composition, except that in use at the time Never enter the laboratory at night unless it is indispensable, and then use a closed lantern with a wax light, allow no smoking or fire near the laboratory —(Aide-Memoire)

Lac — As explained in Balfour's Encyclopædia, is a substance obtained from incrustations made by an insect (*Coccus lacca*) on the branches and twigs of many trees in India The lac is formed by the insect into cells, somewhat resembling a honeycomb, in which the insect is generally found entire, and owing to whose presence stick lac yields by proper treatment a red dye, nearly, if not quite, as bright is that obtained from cochineal, and more permanent Lac is found encircling the branches of these trees in the form of a tube, the broken branches with incrustations at various distances are called in commerce, *stick lac*, which ought to be semi-transparent The colouring matter exhibited by grinding stick lac, and then treating it with water, constitutes *seed lac*, which, when melted up into masses, is called *lump lac* Shell lac is obtained by further purifying the seed lac Lac dye consists of the colouring matter extracted from the stick lac It is met with in small squares similar to indigo, and is used as red dye instead of cochineal Lac dye is largely manufactured in India and exported to England In Bengal, lac is chiefly produced in the forests of Sylhet and at Burdwan, it is also procurable in the Deccan, but Siam and Pegu afford the largest supplies Shell lac is used in Europe for the manufacture of sealing wax, also as varnish, in the latter form it is applied for setting the fulminating charge in gun caps, and in coating Boxer's fuzes and friction tubes

Lacquer—A varnish for either wood or brass, made with shell lac and spirits of wine, in the proportion, for wood, of 2 lbs of lac to the gallon, another recipe is 1 lb of seed lac and 1 lb of white rosin to a gallon of spirits of wine For brass, the proportions are ½ lb of pale shell lac to 1 gallon of spirit It should be made without heat, simply by agitation for 5 or 6 hours It should then be left until the thicker portions have subsided, when the clear liquor is poured off, or if not sufficiently clear, it must be filtered through paper, it darkens by exposure to light, so that paper should be pasted round the bottle to exclude it, or—

	lb	oz
Seed-lac	5	0
Turmeric	2	8
Spirits, methylated	5 gallons	

which will answer for brass fuzes or any other work

Lacquer, Black-Lead—Used for the preservation of the bores

of breech-loading ordnance when laid up in store, composed as follows —

	lbs	oz
Black, lamp, dry	0	12
Lead, black, dry	24	8
Lead, red, do	6	12
Oil, linseed, raw	9	0

The breech screw and bright parts about the guns are coated with a composition of

Tallow	3 parts
Oil, lard	1 ,,

Lead, white, about 1 lb to a gallon

There is a red lacquer composed as follows —Rosin 12 lbs , Spanish brown, 2 lbs , plaster of Paris, 1lb , turpentine, ½ pint, which is used to coat the interior of certain rifled projectiles to prevent premature explosion from friction of iron against powder, which in shells with rapid rotation is very great

Ladders, Escalading—Ladders whose length should be relative to that of the works or walls to be escaladed They are sometimes made in two or three parts, so that they may be more conveniently carried In India, the ladders are made of two longitudinal pieces of bamboo, the transverse pieces of wood being let into the bamboo, and bound round it with strong rope They are of two sizes, 26 and 14 feet long In the Home Service, there are two kinds of escalading ladders, those in lengths provided by Government with other Engineers' stores, and those of an impromptu kind, made for the occasion The first description consists of ladders about 12 feet in length, which fit into one another, so that each joint will give an effective length of 10 feet The second description of ladder is in one length, which is difficult of carriage

Ladders, Fire — Are made of rope or wire, about 70 feet long, and placed on the roof of thatched barracks at certain distances apart The object of the ladders is to enable the men in case of fire, to receive and pass along the roof the pots of water handed up from the ground, which in India, with the assistance of water-engines, is the mode of extinguishing fire

Laid under Metal — In Artillery, implies the depression of the muzzles of ordnance when standing out exposed to the inclemency of the weather, so as to prevent water lodging inside the bore

Lamellar—Formed of thin plates or scales

Lampas—A complaint horses get on the roof of the mouth It is removed by scarification or cautery

Lancaster Gun—The following description of the Lancaster system of rifling, will convey to the reader the form of the gun "If a gun be bored out cylindrically like an ordinary smooth-bored piece, and two grooves afterwards cut, so as to make a quarter of a turn in the whole length of the bore, but with what is termed an 'increasing' or 'gaining twist,' then if the corners of the grooves be chamfered away, the bore will become elliptical in form The projectile was elongated, but instead of the transverse section being cylindrical, it was elliptical, so as to correspond with that of the bore, and consequently the projectile could only pass through the bore by rotating (¼ of a revolution) round its longer axis The gun was of course muzzle-loading, and, therefore, had a certain amount of windage, the shells were made of wrought iron, for the tendency to 'jam' in the bore was so great, that cast iron would not stand This tendency to jam is

one of the principal objections to this system of rifling, whereby the bursting of the gun and fracture of the shell is caused."

Lance — This offensive weapon which consists of a wooden shaft with a sharp point attached to it, is of very ancient date. It derives its name from the Latin word *lancea*. Amongst the Romans and other ancient nations, the lance was used more as a javelin than as a pike, and was not introduced into modern armies as a cavalry weapon until the time of the first Napoleon, who organised several regiments of Polish Lancers for the service of the French Army. In the middle ages, and during the crusades, knights were invariably armed with the lance or spear. It is doubtful whether the lance is as effective a weapon for cavalry as the sword. Its value in pursuit is incontestable, but at close quarters the sabre is a superior and more handy weapon. During the Sutlej campaign, the 16th Lancers in charging the Seikh Infantry are said to have suffered from wounds on the arm inflicted at the moment of thrusting the lance, by sword cuts from wounded Seikhs. This fact shows the necessity of the lance arm being protected by some sort of defensive armour. The shafts of lances are made either of ash or beech wood, but bamboo has been found very good.

Lance Corporal—The lowest rank of Non-Commissioned Officer in the Army. He is distinguished by a chevron on the arm.

Lancers—A regiment of cavalry armed with lances. They are also armed with a sword and pistols.

Lands — In Artillery, the space between the furrows or grooves of a rifled gun.

Landsturm — The volunteers of Prussia. In time of war, they remain in the country, and under no circumstances follow the regular army.

Landwehr—The militia of Prussia. Strictly speaking, it is a defensive army, but in the late war between France and Prussia it was converted into an invading force.

Langrage or Langrel — Case shot made up of pieces of iron of irregular shape and size.

Laniard or Lanyard—Is a thin cord, with a hook attached to one end of it, for pulling the friction bar out of a friction tube, after it is placed in the vent of the gun, by which means the tube is ignited and the flame conveyed to the charge. The hook is placed in the eye of the friction bar, and at the other end there is either a loop or a wooden toggle. There are five sorts of lanyards for firing friction tubes, all of which are described in Majendie's Treatise on Ammunition.

Lansquenets—German foot soldiers used towards the end of the 15th century. They enlisted voluntarily, and hired themselves out as mercenaries to any power which was willing to pay them. Charles VII of France first added them to his infantry. After the sixteenth century the name fell into disuse.

Lanterns—In the Artillery Service, are used at night in the batteries, in the park, or on the line of march; they are of two kinds, Dark and Muscovy.

Lapel—Facings of a coat.

Lapping — Is the first process a rifled gun undergoes after "proof," and before it is issued, for the purpose of removing any little burrs which may be thrown up on the edges of the grooves by the proof rounds.

Lascars — Native seamen, originally from the Malay archipelago. The

name is commonly given to the native sailors used in the mercantile marine

Lashing—Rope used for securing sheers, guns, and any articles that require to be fixed There are three kinds used for lashing—log line, seizing line, and Hambro' line Lashings used in mounting and dismounting guns, are pieces of 2-inch rope, 1, 2, and 3 fathoms long

Lasting Cloth — A material similar to prunella cloth, only thicker, which is used for the clothing of mill-men in powder houses It has the property of not readily catching fire

Lateral—This term in gunnery is used to express the deviation to one side or the other of the vertical plane passing through the axis of the gun, which a projectile is often observed to take in its course

Lathe — The common foot lathe is a machine for turning metals or wood, by causing the material to revolve on central points, and cut by a tool held by the hand or fixed in a slide rest There are other lathes which are self-acting and self-adjusting, which are adapted to plain and circular turning, screw cutting, and boring Amongst the self-acting lathes is Whitworth's patent duplex lathe The peculiarity in this lathe consists in the employment of a cutting tool at the back of the lathe, in addition, and opposite, to the tool in front, but in inverted positions each to the other The transverse forces are thus balanced, and the work produced is more correct, and accomplished in less time than by the ordinary lathe A lathe consists of four parts the frame, head-stocks, which have also the differential pulleys to allow the velocity to be changed, the rest, for the tools, and the corresponding differential pulleys upon the shaft communicating motion

Latitude — In geography, the latitude of a place is its angular distance from the equator measured on the meridian, and can never exceed 90° It takes its name according to the situation of the place North or South of the equator, therefore all places lying at the same distance from, and on the same side of the equator, are said to be under the same parallel of latitude Parallels of latitude are circles parallel to the equator The latitude of a heavenly body is the arc of a circle of latitude intercepted between its place in the celestial concave and the ecliptic

Laying a Piece of Ordnance—In gunnery, is to point a gun so that the projectile shall strike the object aimed at This is effected in smooth-bore guns by elevating the gun to the angle required to reach the object, by means of the elevating screw and tangent scale, the latter regulating the requisite degree of elevation necessary when the object to be fired at is beyond " line of metal range " The usual tangent scales with smooth-bore guns are graduated to degrees, half and quarter degrees In muzzle-loading and breech-loading guns, the tangent scales are graduated to yards as well as degrees, and both natures of ordnance are sighted alike, M L and B L, *viz*, on each side of the gun, but the M L guns have in addition short centre, hind, and fore sights Formerly guns which had no tangent scale were elevated by means of the quarter sights or quadrant

It is sometimes found in consequence of the unevenness of the ground, that one wheel stands lower than the other, under these circumstances the gun will throw the shot out of the true direction towards the lowest side, it should therefore not be laid directly on the

object, but a little to the side of the highest wheel, how much, experience only can teach, and this must be increased in proportion to the difference of the level of the wheels and the increase of the range

Lead—A metal of bluish white colour, and lustrous, tarnishing rapidly by contact with the air, specific gravity when pure, 11 840, fusible at 601° Faht, and volatilizes at a red temperature Lead in arsenal workshops is used in preparing solder for brass, making leaden balls, &c It is received from England in "pigs" and "sheets"

Lead-Harness—The furniture or trappings belonging to the centre and leading horses of a team

Lead, Rod—Is used in the manufacture of compressed bullets The squirting machine for forming the lead into rod, consists of a hydraulic press the ram of which is keyed on to a piston, working in a cylinder immediately above it A charge of melted lead is poured in through the side of the cylinder, near the top of which is a die of the diameter of the rod required The charging hole being closed, and the lead having been allowed to cool down to a point short of congelation, the water is pumped in below the ram, the piston rises and carries the lead up against the die, which being then the only exit, the lead is squirted out in the form of rod, at the rate of between 30 and 40 feet per second The specific gravity of this rod has been found to be 11 334 The following chemical examination of lead for bullets is herewith given, taken from the Woolwich Instructions

Preliminary Arrangements and Precautions

"If distilled water cannot be procured, *rain water* may be used instead, provided it remains perfectly bright when mixed with a small quantity of chloride of barium This should be tried by adding a few drops of the test to some of the water in a test-tube

"In obtaining a fresh supply of *nitric acid*, its purity must be ascertained in the following manner

"Pour two measured drachms of the acid into a dish, add about 12 drops of chloride of barium, and then evaporate to dryness over the lamp When the dish is cool, dissolve the solid residue by adding sufficient water to half fill the dish, and then pour the solution into a beaker If the liquid is not quite clear, the nitric acid is not sufficiently pure

"The lead to be examined must be scraped perfectly bright, and then cut into small fragments

"The dishes and glass vessels, after having been cleaned, must always be rinsed out with distilled or rain water before use

"The exterior of the dishes and flasks must be carefully dried before they are placed over the lamp, the liquids must never be allowed to boil violently, and a cold liquid must never be poured into a hot vessel

"*Examination of the Lead*—Place 200 grains of lead fragments in a conical flask, add six drachms of nitric acid and twelve drachms of pure water, place the flask on the gauge over the spirit lamp (using a *small* flame) and heat gently, until the lead has thoroughly dissolved

"If the solution of the metal is perfectly clear, there is no considerable amount of *antimony* or *tin* in the lead, 0 2 or 0 3 per cent of these metals would render the liquid quite turbid

"The liquid is poured into a dish and evaporated to dryness over the lamp.

When it is nearly evaporated, the liquid must be continually stirred with a glass rod, otherwise it will spirt violently

"If the dryness is *green*, *copper* is present This effect is produced by a very small quantity of that metal Notice need therefore only be taken of this metal when the liquid, after partial evaporation, possesses a decided blue colour Iron may also be recognised by its imparting a reddish *brown* colour to the dryness

"Add about 4 ounces of pure water to the dry substance in the dish, stir and heat gently until the solid has dissolved, then pour the liquid into a beaker glass If it is perfectly bright, or only faintly turbid, the lead is free from any appreciable amount of *antimony*, *tin*, *arsenic*, and *sulphur*

"If there is any considerable amount of sediment in the liquid, the latter must be passed through a filter (supported in a funnel on the tripod with a triangle placed across it, and the paper moistened with pure water from the jet before the liquid is poured upon it), the clear solution (B) is collected in one of the large flasks When it has quite passed through the filter, the flask is removed and an empty beaker substituted

"*The substance on the filter* is washed by pouring pure water into the filter from the jet, until a few drops of the water (collected in a test-tube as they drip from the funnel) remain quite bright after addition of a drop or two of *sulphuric acid* Fill a test-tube to about one-sixth with *hydrochloric acid*, add an equal quantity of pure water, heat the mixture for a short time, and then pour it slowly round the sides of the filter, having first placed the funnel in a clean test-tube, if any portion of the substance on the filter is not dissolved, it shows that the lead contains *tin* Add a drop or two of *chloride of barium* to the acid liquid, if a milkiness is produced, it is due to sulphuric acid, and shows that the lead contains *sulphur* Place a small piece of litmus paper into the liquid (whether clear or turbid), add ammonia gradually, until the colour of the paper is permanently changed to blue, and then a few drops of *sulphide of ammonium*, warm the mixture in the test-tube or in a dish and then filter, collecting the clear liquid in a small flask Add *hydrochloric* acid to the liquid gradually, until a piece of litmus paper, placed in it, is permanently reddened, and heat to boiling If the substance which separates has an *orange* colour or tint, *antimony* is present (the colour should be deep, if the quantity of antimony is at all considerable) Arsenic is indicated by a *yellow* colour, which may be masked by the colour of the antimony, in which case the latter is present in considerable quantity If the substance separated is white or green, it consists only of the sulphur separated from the sulphide of ammonium, and the absence of arsenic and antimony in the lead is proved The solution in the flask (B) is mixed with three or four drops of *hydrochloric acid*, and then boiled, sufficient pure water having first been added to fill the flask about two-thirds If the curdy white substance which is first produced dissolves completely when the liquid boils, the lead is free from any appreciable amount of silver, but if any of the substance remains insoluble after the boiling has been continued a short time, the presence of that metal is indicated"

Leader, Rocket—For firing a number of rockets simultaneously The pattern approved of is fitted with nine

short pieces of quick match instead of ten, at intervals of 3 feet, it is 34 feet in length and has 5 feet of leader clear at each end

Leading Rein—Is attached to the near side of the bit of the off horse, and held in the driver's right hand It consists of a single strap, and enables the driver to keep the off up to the near horse

Leaf Sight — Attached to all Armstrong guns, some having a + sight on the leaf, others a V shaped sight

League—A measure of length, varying in different countries according to the number of geometrical paces it contains A league at sea consists of three nautical or geographical miles, or the one-twentieth of a degree, and consequently about 3 45 English miles

Leather—Is the hide of an animal after undergoing the process of tanning Hides for the purpose of being manufactured into leather are plentiful, and readily procured in most parts of Upper and Lower India, those in most general use being the buffalo and cow hides The chief mart to which they are brought for sale is Calcutta, where they pass into the hands of the English merchant for exportation to Europe, or to the tanner to be manufactured into leather Hides are generally brought to the tanner in a salted or dry state with the hair on, the removal of which is the first process the hide or skin has to undergo It is then steeped in water from 12 to 24 hours, with the view of softening the hide and extracting the salt, to assist this, it is once or twice worked over on a wooden bench or "beam" with a blunt curved knife to complete the softening, it is then transferred into powerful fulling mills called "shocks," worked by machinery, in which the hides, say 50 or 60 at a time, are pounded or pressed until they become perfectly soft and pliable, as if just taken from the back of the cattle They are now well washed in two or more fresh waterings, and again straightened or rubbed over on the beam, which prepares them for the liming process During this process the hides are passed through a paste of lime and water, so that both sides are well covered, and then thrown into a heap for 12 hours or so, after which they are thrown into lime-pits and covered with strong lime water, in which they remain from 2 to 10 days, the time to be regulated according to the nature of the hide itself and the state of the weather The hides are again spread upon the "beam" and unhaired by scraping with a curved knife, until all the hair has been removed This operation has to be repeated several times, so as to leave no chance of even the root of a hair being left, and also with the view of softening the grain The inner or flesh side of the hide has now to be examined, and all extraneous matter, such as bits of flesh, &c, removed by a sharp currier's knife All irregularities in the substance are also to be adjusted by shaving those parts which are too thick The final process is now arrived at of preparing the hides for either tanning or loshing, *i e*, converting it into buff leather

For tanning, the hide has to pass through a chemical process of softening or graining, this is done in various ways by the application of acids The process is a delicate one, requiring much care and attention, as without being thus thoroughly treated, a good leather cannot be produced, and if slightly overdone, putrefaction at once takes place, and the hides are lost.

The hides are now washed in clean water, and passed into the hands of the tanner The tanning process, or converting the prepared hides or skins, is a tedious one, requiring several months, and in some cases (according to the substance of the hide) even years, to thoroughly impregnate the pores with tannin Many patents and experiments have been tried in England to facilitate the process of tanning, some of which have also been tried in Calcutta, but on all sides it is generally acknowledged that the slow and most natural process invariably produces the best and most durable leather Tannin is an astringent solution extracted from various barks and nuts of trees Those chiefly in use in Bengal are the nut known in commerce as the "myrabolain," "gambier," and the bark of the babool tree The first and last of these have to be ground or crushed as fine as possible by powerful machinery made expressly for the purpose These substances readily yield their tannin qualities, and by soaking in water form a strong astringent solution called "ooze"

Our last reference to the hides left them in a state ready for the tan pits, which are usually made of wood The hide is now steeped in one of these small pits termed "handlers," containing merely spent ooze, or such as have little of the tannin property left in them In this they are handled for a few hours, when it is changed for a fresh and somewhat stronger ooze The process is repeated several times, each time increasing the strength of the ooze, until the pit is thoroughly and evenly coloured They are then gradually passed to the larger tan pits, in which they are spread out, several hundred "pelts" in a pit, with layers of crushed bark and ready prepared ooze During the process of thoroughly impregnating the "pelt" with tannin, which, as before mentioned, occupies several months, they have to be thrown up, and each time fresh supplies of crushed bark and prepared ooze applied When the hide is thoroughly tanned, the fibres are of one uniform colour throughout, and it is then in a fit state to be dried out and transferred to the hands of the currier, by whom it is prepared for the various purposes of trade and commerce

Leave of Absence — In the Indian service includes three kinds, *viz* —

1 —Furlough in or out of India

2 —General leave on private affairs or sick certificate in India, or short leave to sea

3 —Privilege leave

In the rules which govern an officer's furlough in or out of India there is no distinction between sick and general leave with respect to allowances hitherto drawn, both being included under the general term "furlough," provision, however, being made for the obtainment of leave under medical certificate without all the restrictions applicable to furlough when taken without it In the rules under the head of "Furlough," it is shown that an officer of the Indian army must serve six years after his return from England or elsewhere, before he is entitled to any more leave counting as service, but should the officer in question have accumulated leave, so that after two years' absence he has still one or two years' leave due to him, he will be permitted, three years after his return, to proceed again on leave without loss of appointment Thus, by way of illustration, should an officer have four years' leave to his credit, he

may take two, return to India for three years, and then proceed again on leave

An officer may take sick leave as often as he is directed to do so by a Medical Board, but all leave in excess of what he is entitled to by the furlough rules will have to be made up again in completing his service for pension Again, absence on medical certificate for a longer period than two years at one time, or departure on such furlough within three years of the date of return from a previous furlough of not less than one year, will involve forfeiture of appointment This may, however, be extended to a third year on English pay An officer of the Royal (late Indian) Service, such as the Artillery, Engineers, and new Line Regiments, and who is on staff employ, may proceed under the rules of 1868 to England for two years without loss of appointment, even should it be a five-year appointment, but the time he is absent will be deducted from the five-year tenure

An officer in the British Army, and holding a five-year appointment, if proceeding on leave on medical certificate, can only do so for six months, retaining his appointment To regimental officers of H M British service, the furlough rules of 1868 are not applicable

With reference to the next head, *viz*, leave in India, it is ruled that an officer, if he wishes it, may take all his leave in India, under the same circumstances as if he went to Europe Further, an officer may take short leave in India, for six months in a year, without forfeiture of appointment, but should he take advantage of this for a third year, he will lose his staff appointment

Then again, an officer may take six months' leave on medical certificate, and have it renewed for another six months, should his health require it, limiting the absence to one year without forfeiture of appointment, which will not be looked upon as furlough, but will be held to constitute a part of the maximum period of eight years' leave of absence to which an officer is entitled in his entire period of service

Short leave not exceeding three months may also be taken to sea on the condition mentioned in the above paragraph, but absence from India for any longer period will be treated as furlough

Privilege leave for 60 days in each year is granted to all officers in military employ should this time be exceeded, it must be converted into general leave, unless sickness has been the cause of detention

Ledger—A debtor and creditor account book in which the entries from the day book are made

Legion—In the common acceptation of the term, signifies any large body of men, and is applied to a distinct force of horse and foot serving with an army Such, for instance, was the British Legion which served in America, and the Spanish Legion in Spain The term legion in antiquity was given to a body of Roman infantry, which usually consisted of ten cohorts, or 5,000 men This, however, does not appear to have been a fixed number, as at different periods in Roman history the legion varied from three to six thousand men

Length of a Gun—In smoothbore guns is the distance between the rear of the base ring and face of the muzzle, measured in a line parallel to the axis The length of B L rifled guns is measured from behind the

breech to the face of the muzzle, the breech screw not being included, of M L rifled guns, from the neck of the cascable to the face of the muzzle The length of a mortar is the whole distance from face to breech, measured along the axis Experience has shown that it is not desirable to make the length of a gun more than eighteen or twenty calibres The reason of this seems to be, that this length ensures the total combustion of the charge, and for any increase of length over what is necessary to insure this before the ball leaves the muzzle, a loss of velocity follows from the friction of the ball against the sides of the bore

Length of Projectiles—This, as is shown in Captain Orde Browne's Treatise on Ammunition, necessarily varies in the different descriptions of projectiles for the same gun, inasmuch as it is to some extent subordinate to the consideration of bringing them all (with certain exceptions) to the same weight, but it has been decided that a length of two calibres at least is necessary for very accurate shooting, and it is desirable for good "*vis viva*," or destructive effect on impact at any but very short ranges, to have the weight great in proportion to the calibre, or in fact to the surface of resistance, and of course this is favoured by an increased length of projectile

Lens—A portion of any medium bounded by two spherical surfaces having a common axis, or by a spherical surface and a plane one

Letter of Marque—A letter or commission formerly given by the Admiralty, or admiral on a station, in time of war, to the commander of any private vessel, authorising him to cruise on the seas, and capture any of the enemy's ships or property found on the seas or in harbours

Levee—This term originally meant visits of ceremony paid in the morning among persons of rank It is now understood to mean an assembly at Court on State occasions of those of Her Majesty's subjects who are entitled to the privilege, to do honour to the Sovereign The privilege of holding levees is accorded also to Her Majesty's representatives at home and abroad

Levee en masse—The general rising of a nation in self-defence to repel invasion, or to answer the intentions of its governing powers

Level—An instrument for determining the difference of height between any two objects or places

Level, Spirit—A glass tube closed at the ends and nearly but not quite filled with water or spirits, fixed in a piece of wood or metal, with a flat base to which the tube is perfectly parallel, when placed on a level surface, an air bubble will be at the centre of the tube Of spirit levels used in connection with instruments for measuring the differences of level, or vertical distances between different stations, are the Y level, Troughton's improved level, and Gravatt's level

Lever—"A straight and solid bar turning on an axis is called a *lever* The *arms* of the lever are those parts of the bar extending on each side of the axis The axis is called the *fulcrum* or *prop* Levers are commonly divided into three kinds, according to the position which the fulcrum has in relation to the power and weight If the fulcrum be between the power and weight, the lever is of the first kind If the weight be between the fulcrum and power, the lever is of the second kind If the power be between the fulcrum and weight, the lever is of the third kind Of whatever kind the lever may be, the conditions of equili-

brium of the power and weight will be such, that they are inversely as their distances from the fulcrum, this being the general condition of equilibrium for all machines which turn round a fixed axis (Lardner)

Lever, Armstrong Gun—Is the iron handle which is fitted on the circular portion of the breech screw end, and revolves with it It is kept in its position, endwise, by two split keep-pins, working in grooves, turned on the breech screw The object of the lever and tappet arrangement is to gain a powerful momentum in tightening up and releasing the vent piece from its seat in the gun

Levigation—The reducing of hard bodies to a very fine powder by grinding with water

Levy—In the military acceptation of the term, the act of raising men for the defence and safety of a country

Lewis—An ingenious mode of lifting heavy weights It consists of three pieces of iron, two of them wedge shaped, and the third straight, which, when placed together with the straight piece in the centre, form a dove-tailed wedge The lewis is inserted in a hole of similar shape, which is cut in the stone To the end of each of the pieces a ring is attached, through which a horse-shoe ring is passed, and to this latter the rope or chain is fastened

Lieutenant—The rank next to a Captain This word is originally derived from the Latin *legatus, locum tenens,* and comes immediately to us from the French *lieu-tenant,* supplying or holding the place of another The Senior Lieutenant takes the command of a company upon the absence or death of the Captain

Lieutenant-Colonel — The next rank to that of Colonel in the Army This officer commands the regiment in his own right, if senior, regimentally, of that rank , and upon him devolves the care, responsibility, and discipline of the officers and soldiers under his command

Life-Guards — The mounted body-guard of the Sovereign In the British Army there are three corps, two termed Life-guards, and the third the Blues They never leave the country except on great emergency These regiments were present at the battle of Waterloo, and greatly distinguished themselves

Life-preserving Apparatus—*Vide* Manby's Shot

Life-time—As applied to cannon, is the length of time or the number of rounds a piece of ordnance will stand before it becomes unserviceable This is estimated in smooth-bore ordnance at from one thousand to twelve hundred rounds with service charge and one shot Experience, however, has shown that it is not so much the number of rounds fired which destroys a gun, as the high elevation given to it to obtain extensive range Guns fired horizontally, or at no greater elevation than 5° or 6°, do not experience the great strain that a gun fired at 30° would, and the reason is obvious, as guns fired at a low elevation recoil in proportion to the relative weight and friction of the projectile, whereas when elevated to 30°, the gun cannot recoil, the force therefore is exerted downwards, and the gun impinges on its support, which is comparatively immovable , thus the force which displaced the gun in the first instance, is now exerted on the sides of the gun The initial velocity is also increased with the angle of projection, which causes the shot to press more upon the charge and thus to increase the resist-

ance of the expansion of the gases This increased resistance also adds to the strain upon the gun The new bronze rifled gun for India has stood upwards of 2,500 rounds

Light Balls—Are thrown from mortars at night, to discover the operations of an enemy They continue alight from 10 to 20 minutes Light balls are of four different natures, *viz*, 10 inch, 8 inch, 5½ inch, and 4⅖ inch Their form is oblong The skeletons are made of wrought iron, and are coated with canvas called "Osnaburg," which is 24 inches wide

The proportions of composition are as follows

	lbs	oz	drs
Saltpetre, ground	6	4	0
Sulphur, ground	2	8	0
Rosin, pounded	1	14	0
Linseed oil, boiled	0	7	8

Light Cavalry—As their name implies, are a body of men who from their light equipments and active horses are especially adapted for making long marches, performing outpost duties, skirmishing, &c Such are the Uhlans of the Prussian Army In the British Service the Light Cavalry consist of the Hussar and Lancer regiments

Light Infantry — Were formerly a body of active and strong men selected from the aggregate of regiments in the service, and made up of promising recruits They are now, as far as any distinctive characteristic in uniform is concerned, abolished , but the light infantry regiments still borne on the Army List, and whose appellation is purely honorary, can be distinguished by their equipment, from their having bugles instead of drums, and wearing a green plume in the shako instead of a ball tuft, further, they bear the bugle on the forage cap and knapsack.

Lightning Conductor—*Vide* Copper Rod

Lignum-Vitæ—A wood which grows in the West Indies and South America It is very hard and heavy, indeed one of the heaviest of woods Lignum-vitæ is much used in machinery, and for a variety of works requiring hardness and strength This wood contains a large quantity of gum guaiacum

Limb—The graduated arc of a surveying instrument

Limber—A carriage mounted on two wheels of the same height as the gun carriage, and to which the horses are attached A light field limber consists of a frame-work of wood, which is composed of three futchels, an iron axle-tree, axle-tree bed, foot and platform boards, shafts and a splinter bar Two ammunition boxes are placed on the framing over the axle-tree bed At the back of the limber is an iron hook or pintle to which the trail of the gun carriage is attached, forming for the purpose of transport or manœuvring a four-wheeled carriage

Limber-Up—An order given to the gun detachment of a battery after firing to attach the limber to the gun carriage, preparatory to advancing or retreating

Lime—(CaO) or Oxide of Calcium This very useful substance is prepared by the decomposition of carbonate of lime by heat The operation is carried out on a very large scale in kilns or furnaces Anhydrous lime, or "quick lime," is a soft, white, amorphous solid When exposed to air, it soon absorbs water, the lumps crumbling to a bulky powder, which is hydrate of lime, or "slaked lime" Lime is one of the most infusible bodies which we possess, it resists the highest

heat of our furnaces The uses of quick and slaked lime will be found on reference to Abel and Bloxam's Hand Book of Chemistry Lime is occasionally found in saltpetre It can be detected by oxalate of ammonia

Limit, Founder's—The limitation of error for guns, shot, &c, allowed to the founder

Line—In military affairs, a term given to the regular and numbered troops to distinguish them from the auxiliary troops of the British Army, such as the militia, volunteer, and yeomanry corps The Life Guards, Foot Guards, and Dragoon Guards are not numbered amongst the regiments coming under the designation of the *Line*

Line — According to the drill-book, a battalion is said to be *in line* when its companies are deployed on the same alignment to their full extent, *i e*, in two ranks Columns are said to be in line when their fronts are on the same alignments

Line, Cotton—Used for tent ropes and slow match

Line, Hambro' — A kind of whipcord, and used for the same purpose as log line

Line, Log — Used for lashing to gun aprons, sponge and muzzle caps, &c There is also a log line made in India which is used for choking rockets, for handles for case shot, &c

Line, Seizing — Used on the march for lashing any spare articles it should be well rubbed with tar and grease, being much exposed to the weather It is made up in skeins about 29 feet long and one inch in circumference

Line of Fire—In gunnery, is the production of the axis of the gun directed upon a point which is at a vertical distance above the object to be struck, corresponding to the time of flight required for the range, and at the end of which time the shot will be brought to the object by the force of gravity

Line of Least Resistance—In blasting or mining, is a line drawn from the centre of the charge to the nearest surface of the ground

Line of Metal—In gunnery, the visual line connecting the front and back sight when the latter is at its lowest point, *i e*, connecting the notch on the tangent sight with the notch on the swell of the muzzle, or dispart sight, when the trunnions are perfectly horizontal

Line of Metal Elevation—In gunnery, is the elevation due to the conical form of a gun, when the gun is laid on an object by the line of metal (there being no *dispart patch*) In thus elevating the piece, the prolongation of the axis will pass over the object aimed at

Line of Operations—With reference to the movements of an army, is the line by which it advances from its base into the theatre of war

Line of Sight—In gunnery, is the line drawn from the top of the tangent scale (at any elevation), and muzzle sight, to the object, when these three are brought into the same line, it is called the "line of sight"

Lines—A connected series of field works, whether continuous or at intervals

Lining—In artillery, is the process pursued, after the proving of rifled guns, to enable the manufacturer to adjust the sights and elevating plates

Link—The connecting part of a chain To measure the length of links, the inside dimensions are taken,

as they alone contribute to the length of a chain

Linseed—The seed of the flax plant In India, it is principally used in the manufacture of linseed oil, the oil is contained in the kernel of the seeds (*Linum usitatissimum*) and may be either cold drawn, or, as is usual, obtained after the seeds have been subjected to a heat of 200° It is one of the cheapest fixed oils and is used in the manufacture of paints, varnishes, and printing inks, it is what is termed a drying oil In arsenals, both English and Indian, linseed oil is made use of in its unboiled state, if fresh, and it will be found superior to any other oil When quite fresh it answers very well in making paints, but if not, it requires to be boiled before being used, a quantity of litharge, pounded and wrapped in a piece of muslin, being boiled in it as a dryer

Linstock — Used in a standing battery to hold the slow match It is made of wood, the lower end pointed and shod with iron, the upper end, for holding the slow match, being also made of iron Since the introduction of friction tubes it can scarcely be required

Lip Strap — A small strap with a buckle, passing from one cheek of the bit through a ring in the centre of the curb chain to the other cheek, for the purpose of preventing the horse from seizing the cheek of the bit in his mouth

Listening Gallery — *Vide* Gallery

Litharge — Vitrified lead It is mixed with paint which has been manufactured with boiled oil, and is used as a dryer

Litmus—A violet blue dye, prepared chiefly in Holland from a lichen which grows in the Canary and Cape-de-Verde Islands It is met with in small cubical cakes of a dusky blue colour, light and easily pulverised It is used as a chemical test of acidity, being reddened by acids, while the blue is restored by alkalies, for this purpose it is employed either in the form of a tincture or of unsized paper coloured with it A more convenient and perhaps more generally useful blue test paper is prepared from the red cabbage When this is sliced and boiled in water, a blue solution is procured On this being concentrated by evaporation, it may be used in the same manner as litmus for dyeing paper The colour of such paper is rendered red by acids, and green by alkalies, while it is entirely unaffected by the neutral salts

Litter—A sort of stretcher or hurdle bed on which wounded officers or soldiers are carried off the field of battle The doolie in India performs this service

Live Shells — Shells loaded with their bursting charge ready for service

Lixiviation—A term used in the solution of organic substances from vegetable matters Soluble constituents may be conveniently removed from porous bodies by lixiviation, for instance, washing earths, &c, containing nitre

Load — In gunnery, to "set home" the charge and projectile in a gun Loading is effected either at the muzzle or breech, according to the nature of the ordnance used Most of the Armstrong guns are breech-loaders In muzzle-loading guns, the first operation before loading is to sponge out the piece, this being accomplished, the cartridge is inserted and rammed home, the shot or shell then follows, and care must be

taken that the shot is well rammed home, as any space left between the cartridge and the shot would render the gun liable to burst, it is of the utmost importance that this should be attended to, the gun being loaded is then primed with a friction tube and ready for action In the Armstrong breech-loading guns, a lubricator is used, which cleans the gun out after every round, thereby doing away with the necessity of sponging, except occasionally In loading heavy M L rifled guns, special apparatus is used for lifting the projectile into the mouth of the gun

Loaders—Are used with siege howitzers to steady the shell in its passage down the bore The fixed iron band which crosses the hollow hemisphere of the loader has a hole in it which embraces the fuze, and which on reaching the bottom of the bore can be easily disengaged

Loadstone—A combination of the protoxide and peroxide of iron This term is applied to the magnetic iron ore, or natural magnet, from an early observation of its most useful directive property by various nations It is derived from the Icelandic word *liederstein*, or the leading stone, from the Saxon *lædan*, to lead, whence the English name *load* or *loadstone*

Loam—A native clay mixed with quartz, sand, and iron-ochre, and sometimes with carbonate of lime

Lock—In draught, this term is applied when putting on the drag or locking chain to a wheel

Lock, Gun—As attached to naval guns, was introduced into the British Naval Service as early as 1778 It appears that they were then flint locks, and continued in use until 1818, when the double flinted locks invented by Sir H Douglas were ordered for general use in the Navy These were recommended by that officer also for land guns, whether field, siege, or garrison, and the recommendation was strongly backed by the late Sir A Dickson, of the Royal Artillery Subsequently, the discovery of the percussion principle having been made, percussion locks and tubes were introduced, but since the introduction into the Navy of Col Boxer's friction tube, made with a quill, the percussion lock has been superseded

Locking Angle—The turning angle of carriages, or the angle formed between the gun carriage and limber, when the wheel of the latter comes in contact with the locking plate on the trail

Locking Chain—The chain attached to a gun carriage to retard its progress in steep descents It is fastened underneath the carriage

Locking Plate—Is fixed to both sides of the trail of a field carriage, about two-thirds the distance between the checks and the end of the trail, and is so placed, that when the carriage is turned round at a very acute angle, the wheel, though it comes in contact with that portion of the trail, can do it no injury, as the plate acts as a fender

Lodgment — In gunnery, the hollow or cavity in the under part of the bore where the shot rests when rammed home, formed, in smooth-bored ordnance, after much firing, from the elastic force of the powder acting upon the upper surface of the projectile, and forcing it down, so as to occasion an elliptical indentation

Lodgment—In fortification, an intrenchment hastily thrown up on a captured breach or outwork, in order to maintain the position against recapture.

Logarithm—The logarithm of a number is the power or exponent of any other number, called the base, to which the latter must be raised to equal that number For instance, 10 being the base, the logarithm of 100 is 2 (10^2), of 1000 (10^3), &c

Log Line—Small cord

Longe — The training ground for the instruction of a young horse, to render him quiet and tractable, as well as supple, to give him free and proper use of his limbs, to form his paces, and to prepare him in all respects for the Cavalry Service

Longitude—Signifies with reference to the earth, its extent from East to West, in contradistinction to its latitude, or extent from one pole to another The longitude of a place is its distance from some given point called the meridian, which is reckoned either East or West The English reckon from the meridian of Greenwich The longitude of a heavenly body is the arc of the ecliptic intercepted between the first points of Aries and the circle of latitude passing through the body It is measured from West to East, entirely round the circle

Loophole—*Vide* Holes

Loot—The Indian term for plunder, or pillage

Low Pressure — In a steam engine, is when the steam is drawn off into a condenser The term is applied to a condensing engine

Lubrication — The oiling or anointing with grease or fatty substance, surfaces which come in contact with each other For the composition used in the lubrication of axle arms *vide* Grease

Lubricator, Boxer's — Consists of a disc of milled board, a thick felt ring, and an air-tight vessel of very thin copper filled with equal proportions of tallow and oil Bees' wax is used as a lubricator for rifled small-arm ammunition, each cartridge being dipped in melted bees' wax raised to a temperature of 210° Faht

Lubricators are used with Armstrong guns to cleanse the bore and save the trouble and delay of sponging the gun after each round

Lug—The ear or loop of a shell

Lunette—A work larger than a redan, with two faces and two flanks It is much used in field fortification, and is sometimes placed on the capitals of the works in a permanent fortification, in advance of the glacis, to cover some ground which it is desirable to occupy

Lute — Chemists' clay or loam, it is used in closing a retort placed in a receiver for the purpose of excluding the air There is also a mixture termed "lute composition" used for keeping the bungs of powder cases air-tight it is composed of tallow and bees' wax

M.

Machicoulis Gallery — Is one of the means resorted to in the defence of buildings It is constructed over the entrance to a house or enclosure, or over posts where an opening is liable to be effected, the floor being perforated to enable the defenders to fire downwards A balcony may be converted into a Machicoulis Gallery by making the front and sides bullet-proof, and forming openings in the floor, so as to enable a perpendicular musketry fire to be directed upon the enemy below

Machine—In a general sense, is any thing that is used to augment or to regulate moving forces or powers The term is generally restricted to a certain class of agents which seem to

its diameter, and its weight about half that of a solid shot of similar diameter This nature of shell is filled with bullets, and the bursting charge poured among them, which is ignited by a fuze, the bullets proceeding on their course with the same velocity which the shell had on bursting The object in using shrapnel shell is to give the projectile at long distances the power and efficacy of case shot, it is most effective when used against masses of troops, and the fuze should be so adjusted as to cause the shell to burst 50 yards short of the object fired at This pattern shell is now obsolete, having been superseded by Col Boxer's Diaphragm Shell, which is only used with smooth-bored ordnance

Shellac— *Vide* Lac

Shelling—Assault of a place by means of shells, bombarding

Shelter Trenches—As stated in the Instruction in Military Engineering, 1870, the increased power of the improved rifled arms of the present day renders it more than ever necessary that cover should be provided for troops in action. This can be best obtained where natural cover is not at hand, by means of small trenches called *shelter trenches*

As explained in the above-quoted work, " it is essential that there should be ready means of getting in and out of these trenches both to the front and the rear, it is also desirable that they should not offer any great impediment to a forward movement, and that troops should be able to march straight over them when necessary At every 100 yards or so, to enable guns, cavalry, &c , to pass, slight ramps should be formed, or intervals left in the trenches, which may at these places be made to overlap

" The most rapid way for infantry to obtain cover, is by the excavation of a trench 2 feet wide and 1½ feet deep , the earth is thrown to the front, so as to form a parapet 1½ feet high, the interior slope being built up as steep as possible with sods, clods, &c Such a trench can be executed by men with their accoutrements on, and distributed at from 4 to 6 feet intervals in from 10 to 20 minutes "

Shield—Defensive armour of very ancient date, and worn even at the present day amongst nations where civilization has not made much progress Shields have been made of wood, iron, and basket work, and were carried on the left arm in defence, while the right arm wielded the sword or spear

The term " shield " is also given to those massive structures of iron which are used as an outer casing to the granite or brick walls of masonry of a fortification, or as covers to embrasures Shields of all dimensions, representing the sides of plated armour ships, have been set up from time to time at Shoeburyness, for the purpose of testing their resistance to rifled projectiles

Shoes, Powder—Are made of leather, unblackened, and sewn together They are of larger dimensions than the usual shoes They are used in all mill-houses where the manufacture of powder is carried on, and no one is allowed to enter a powder-house without first slipping them on

Shot—An iron sphere cast either solid or hollow There are several projectiles designated *shot,—viz* , round (solid and hollow), case or canister, grape, bar, and chain shot , the two latter are now obsolete Since the introduction of rifled artillery, elongated shot have been introduced and are used with both breech and muzzle-loading

guns, with the former, Armstrong's solid shot, and with the latter, Palliser's shot of 12, 10, 9, 8, and 7-inch calibres

Shot, Case—*Vide* Canister

Shot, Chilled—Shot formed by pouring liquid grey cast-iron into a cold metallic mould, so as to cause the most sudden cooling possible By this process, which has been introduced by Major Palliser, the surface of the shot is rendered extremely hard, and capable of penetrating iron-plated ships It has been found only necessary to chill the head of the shot, and to let the body be cast in sand (*Vide* Moulds for casting Shot or Shell)

Shot-garlands—Are used to retain shot placed on defences they are made either of iron or wood Hitherto garlands have been made of cast-iron and of a square pattern, but they are to be used up and replaced by wrought-iron of a rectangular form They preserve the shot from deterioration, and it is usual to place a tier of unserviceable shot under the serviceable pile

Shot-gauge—*Vide* Gauge

Shot, Grape—*Vide* Grape

Shot, Hollow — Were introduced into the Naval Service with the 8 and 10-inch shell guns before iron-plated ships were built, with the view of enabling ships to carry a comparatively light gun with projectiles of larger diameter and less charge of powder than are required for solid shot In long ranges the hollow shot is undoubtedly inferior to solid shot, and it is only in short ranges, when the hollow shot can penetrate a wooden ship's side, that the magnitude of the fracture, as well as its splintering and shattering effects, will be greater than those produced by the solid shot In long ranges the hollow shot is very liable to lateral deviations, as might be expected from its lightness, the deviations taking place principally near the further xtremity of the trajectory

Shunt Gun—A muzzle-loading rifled cannon, introduced by Sir W Armstrong, on what he terms the *shunt* principle In the shunt gun, the projectile is introduced into the piece on ribs or buttons, but with this peculiarity, that the projectile enters by one set of grooves and comes out by another set Or, as explained by Lieut-Colonel Owen, "when the shunt gun is loaded, each stud presses against the (*loading*) side of a groove, and runs easily home, being *shunted* on its way down into the narrow portion of the groove, but on coming out again, it presses against the (*driving*) side, and near the muzzle rises up the incline into the shallow part, or on the *high level*, and so is slightly compressed, the projectile therefore leaves the bore fitting tightly, and with its axis stable"

Sicklegħar—An Indian term A native of India employed in arsenals for cleaning metal work

Siege—A regular organized attack on a fortified position, by means chiefly of artillery

The term comes from the French *siège*, which signifies a seat, chair, &c Hence to "sit down before a place" signifies, in a military sense, to choose a position from which you may commence the necessary operations to attack and get possession of it

Siege Artillery — Before the introduction of rifled guns, siege artillery consisted of the 24-Pr gun of 50 cwt, the 10 and 8-inch howitzer, the 10 and 8-inch iron mortar, and the 5½ and 4⅖-inch brass mortar It now consists of the following, with the proportions shown for what is termed a *Siege Train, viz*

naturalised in some parts of India, where it belongs to another genus, and is decidedly inferior to the real mahogany This last, however, ha been grown in the Botanical Gardens, Calcutta, and pronounced very favorably upon, showing that the true variety may be grown in the East Indies It is found in some of the Tenasserim gardens, where it appears to flourish Professor Royle in his Productive Resources of India, states, "the tree is now common in Northern as well as Southern India"

Mail—Primarily denotes the holes or meshes in a net It likewise signifies a round iron ring, hence coat of mail,' a coat of armour or steel network, anciently worn for defence

Major—An officer next in rank to a Lieutenant-Colonel The duties of a major depend upon the nature of the service on which he is employed Being a field officer, he is allowed, with an Infantry Regiment, to be mounted at all parades and in action In the Artillery and Engineer Branch of the service, as well as in the Marines there is no such regimental rank It appears that this class of field officer did not exist until the 17th century

Male Screw — *Vide* Female Screw

Malingerer — One who feigns illness to avoid his work

Malleable — Flexible, ductile, forgeable In metallurgy, capable of being spread out by heating or by rolling, or under the blows of a hammer In speaking of iron, it is the term applied to wrought iron

Mallenders—A scurfy eruption which sometimes appears at the back of the knee of a horse, which, if neglected, will degenerate into a troublesome sore ending in a discharge It is brought on generally by carelessness and neglect on the part of the stable attendant For the relief of this disease, it is necessary to pay scrupulous attention to cleanliness, giving the animal tonic alterative drinks, as follows—

Liquor arsenicalis	1 oz
Tincture of the muriate of iron	1½ oz
Porter or stout	1 quart

Mix and give one pint night and morning, at the same time apply the following

Animal glycerine	1 oz
Mercurial ointment	2 drs
Powdered camphor	2 drs
Spermaceti	1 oz

thrice daily, after thoroughly incorporating the ingredients If the scurf has degenerated into a sore, treat after the manner for cracked heels (Mayhew)

Mallet—A wooden hammer It is used for a variety of purposes in the Artillery Service such as driving pickets, tent pins, &c, driving rocket portfire, and fuze composition, also for setting fuzes in the larger natures of shells Mallets vary in size and shape, and are made in India of babool, or soondry wood Mallets are also very generally used by mechanics, such as joiners and carpenters, coopers, tinmen, &c

Mallet's Mortar—A monster mortar manufactured by Mr Mallet, consisting at the lower end of a solid cast-iron breech, abutting on which is a series of wrought-iron hoops, following each other in succession up to the muzzle, these are inserted into each other by rebates, and are firmly secured by six iron staves, at equal intervals about its surface, extending longitudinally the whole length of the mortar The total weight of the mortar is 50 tons 13½ cwts, the diameter of the

shell 3 feet, and its weight, when unfilled, 26½ cwt From the result of the experiments which have been made with this mortar, it appears that there is a tendency to separation between the trunnions and the cascable, and consequently there is reason to think that it can never be employed on service

Mamootie—An Indian term for a kind of large-sized hoe, which is used by the natives of India for digging, clearing obstructions on the roads, &c A certain number are carried with siege trains

Man — This term is commonly used in artillery to signify the arming of a battery with men, ready for action

Manacle—An iron hand-cuff for confining the hands of prisoners Manacles are fastened by a lock made in the iron work of the hand-cuff

Manage or Manege—Riding school, training, instruction in horsemanship

Manby's Life-saving Apparatus—Consists of a shot with a line attached, which is fired from a 5½ inch mortar The line is made of plaited hide thong It is used in case of shipwrecks Besides the above apparatus, Colonel Boxer's life-saving rockets have been introduced into the service

Mandrel — The spindle which carries the centre chuck of a lathe, and communicates motion to the metal to be turned, in small lathes, it is driven by a pulley

Mange — An infectious disease which attacks horses when neglected It is brought on from want of grooming, irregular hours in feeding, coarse diet, and a filthy stable It is of the first importance, therefore, to be particular in the cleaning of the horse's skin, which, if neglected, generates in it a small insect, upon the presence of which mange depends Horses are more subject to it in the winter, after putting on their winter coats The cure for it is as follows

4 parts of ghi
1 part mercurial ointment
1 part hellebore

Have the horse shaved, apply the above, and let it remain on three days, the horse must then be washed with soap until it gets in a lather he must then be trotted about till he sweats Let him remain for three days, and then apply the ointment a second time, and after three days he is to be washed again in the manner above detailed, the insects then should all have been killed

Manifesto—A public declaration by a power or state, containing its reasons for entering into a war This custom dates back to a very early period, but the formality of a manifesto has been considerably relaxed in modern times

Manœuvres — In a military sense, the movement and evolution of troops, or in other words, the handling of a body of men on the drill ground or before the enemy For information on the subject of the manœuvres of troops, *vide* Colonel Macdougall's Theory of War, also a very interesting lecture delivered at the Royal United Service Institution in March 1870 by Colonel Shute, "On the military maxims suggested or exemplified by the last autumn manœuvres of continental armies"

Mantlet—A movable shield of metal, used as a protection against the fire of small-arms It is supported on two wheels, and serves to protect the working parties at a siege, or gunners at an embrasure Mantlets are no

longer used by sappers, having been superseded by gabions.

On referring to the proceedings of the Royal Artillery Institution Papers, vol 3, it will be observed that, within the last few years, a variety of mantlets have been proposed of rope, iron, and steel, but none appear to be approved of, either on account of their weight, or in the case of thin iron plates, from their not being adapted for closing the embrasures of guns liable to be attacked directly or replied to by artillery. The value and efficiency of rope mantlets, which were used in the Crimea, are considered undeniable; their cumbrousness appears to be the only obstacle to their more frequent use.

March—The motion of a body of troops from one place to another, either on a campaign or in the usual relief from station to station. The average march in India is from 10 to 15 miles a day. Troops generally set out on the march, during peace time, about 3 or 4 o'clock in the morning, later, in the winter, if marching in the North-West of India. At sunrise the troops halt for half an hour, during which time coffee is served out to the men, the cooks going on the night before to a suitable spot about half way to prepare it. For the order observed in the march of troops, *vide* Field Exercises and Evolutions of Infantry, 1870.

The following rules taken from Colonel Hughe's Instructions* on the management of a troop of Horse Artillery preparatory to the day's march, or while on the march in India, will be found to contain much useful information.

* These instructions were in force in the late Bengal Artillery.

"Preparatory to the March.

1. "The saddlery and harness to be put into complete serviceable condition, to be carefully examined at a parade for that purpose, to be accurately adapted and fitted at two successive parades, and the horses to be put to, and regularly teamed, at two more.

2. "The arms and accoutrements to be put in perfect order and inspected at a parade for that purpose. The men's marching kits to be thoroughly examined and put in good and serviceable condition. A pint soda water bottle, covered with leather, is allowed to each man.

3. "The ordnance, carriages, ammunition, and stores to be carefully inspected by officers and non-commissioned officers in charge of sub-divisions.

4. "The ammunition to be stowed in the boxes by the men of each sub-division, and again returned to the magazine until the troop is ordered to parade in marching order.

5. "Camp equipage to be pitched and inspected, an ample proportion of mallets, pins, &c, to be ready.

6. "Camp colors to be put in order, camp and horse lines laid down and examined, and camp pitched agreeably to the plan laid down, a copy of which the camp color-man should furnish himself with.

7. "The usual reports and requisitions, agreeably to existing orders, to be made for guards, supplies, boats, &c. In a requisition for boats, always state the number of horses and carriages, and require platform boats with bamboo rails for the horses. The number will depend on the breadth of the river to be crossed, the rapidity of its current, &c. On ordinary occasions from 15 to 20 horse boats will suffice.

8. "Shoe up all your horses, and

have two sets of shoes and nails in hand, these should be completed at every opportunity Have enough nails for one set of shoes in addition, to replace such as may be thrown and recovered

9 "Indent for horse medicines and instruments, if no veterinary surgeon is *present* with the troop,—a camel and a pair of camel trunks will be allowed for the conveyance of the instruments A supply of black pepper will be found useful for the horses in wet or cold weather

10 'Provide a well-bucket, and a rope and pulley for drawing water from wells, also hides for steeping gram in

11 "Having every article of horse and stable gear complete for your complement of horses, and in perfect order, take in addition, spare, about ⅛th of your complement of head-stalls, eye-fringes, heel-loops, and pannels for saddles, ¼ of brushes (if on a campaign, two for each horse at least), 1-16th blankets (double), body-rollers, gram-bags, head and heel-ropes, curry combs, and a few sets of spare clothing

12 "Take also a good supply of buffalo and bullock hides, sheepskins, numdah, serge, and wool for the repair of saddles, collars, &c, twine, thread, wax, cotton, gudjee, steel, iron, charcoal, and half-wroughts The proportion of the foregoing must be determined by the state of the harness and other equipments, the nature of the march or service, but a liberal quantity should be taken, so as to ensure against the chance of disappointment, and the stock should be kept up as opportunity occurs Tar and grease boxes to be filled, and a supply of unmixed tar provided

13 "Examine the bullocks for the store and other carts, — pack the carts, — the quarter-master's cart should be reserved for spare arms, troop books, arms of sick men, &c

14 "Public and private carriage to be indented for The bullocks for the extra carts should be of the best description, and are to be minutely examined

15 "Get camels for the conveyance of one day's grass, and provide six grass nets

16 "If you have not a machine for twisting rope, get one made, and lay in a supply of *sunn*, to make rope of—also a supply of *moomroghun* (in stout earthen jars), for the harness and saddlery

17 "When all preparatory arrangements are effected, parade the troop in marching order, spare horses harnessed, and teamed with their respective carriages The horses are to be allotted according to their capabilities,—for marching it may be necessary to break up teams arranged with reference to color Subalterns should minutely examine the teams of the respective divisions Parade the syces and grass-cutters, and select such as are unfit for the march, to be left behind A cotton leading-rope to be supplied for each horse, attached to the head-stall and saddle ring

18 "The troop being thus prepared for the march, must, if time allows, be marched a few miles every morning, for a week or ten days, in order to make the horses feel their collars well, with the full draught of loaded carriages, this is very essential, and if neglected, collar galls will be the sure result, the order of march should be practised on these occasions, that all may readily find their places when marching before daylight

19 "Circumstances will occasion-

ally cause a change, and on service each day will often require a specific arrangement, but regarding a troop of horse artillery as a distinct body, the following may be considered the best arrangement for the order of march

" ORDER OF MARCH

1 "An advance party—and a Rear Guard (from the Quarter Guard coming off duty) of such strength as the complement of the troop admits of

2. "At least two mounted men (one of them a trumpeter, or a half-pay trumpeter), with a party of syces and bildars (if all have not been sent on over-night to the new ground), should form the advance party and precede the troop from 200 to 250 yards, to remove obstacles, and ascertain the road A guide should be attached to this party In case of any obstacle presenting itself, not removable in time, notice is to be sent back to the head of the column It may sometimes, in narrow defiles, be necessary for the trumpeter to sound the *Halt*, but this is only to be done when time does not admit of any other mode of communicating

3 "At 100 yards in advance of the troop, midway between the head of the column and the advance party, there should be another party of one or two mounted men to keep up the communication with the advance, and prevent any obstacles intervening (the spare men of the leading sub-division may be employed on this duty if you are short of men) If the road branches, one of this party will halt till the head of the column comes up, point out the proper road, and rejoin his party They must keep sight of the advance party

4 "The advance party, which must always have an experienced and intelligent non-commissioned officer, or an old and steady soldier on it, must examine all fords, notice the breadth of the road or track, and particularly ascertain that the road taken is suited for the passage of wheeled carriages Guides are apt to take short cuts, without reference to the difficulties attending the march of artillery

5 "The order of march of the column will be regulated by the nature of the country and the operations looked for, as also will the number of spare horses with each sub-division

6 "The Rear Guard should consist of the sergeant or other non-commissioned officer of the Quarter Guard, two or four mounted men, it follows in rear of the led horses, and brings up prisoners, and prevents all straggling

" ON THE MARCH

1 "The horses are on no account to be touched until the gun or warning trumpet is heard, when they are to get their feed of gram, and have their legs rubbed while feeding, heel ropes taken off, and heel-pins up

2 "When they have eaten their gram, they should be stripped, their coats smoothed, manes and tails combed, saddled, harnessed, and bridled, and again covered with the clothing, or a blanket, according to the weather It is desirable that the horses should be got ready by the syces under the superintendence of the stable orderly, as the men of the troop meanwhile strike and pack their tents and baggage, and dress themselves

3 "As soon as the horses are fed, the heel-ropes and pegs, gram bags, curry-combs, brushes, watering-bridles, and clothing (or blankets, whichever is not on the horses) are despatched forthwith As ropes only are ordered to be used, two tatoos or mules for each sub-division will suffice for the

carriage of these articles, and if they are forwarded in due time, they will be on the new ground before the arrival of the troop In an enemy's country, it will probably be necessary for these articles to follow the troop, which they should do close up with the rear guard

4 "When the parade trumpet sounds, the head ropes and pegs will be disengaged, and must be taken on by the syces, who move along with the troop The horses are put to, and still remain covered with clothing or blanket till the order is given to mount, when it is stripped off and taken charge of by the syce, who will thus have in charge the head-rope and pin, and the blanket or clothing, and with these articles he is required to keep up with the troop, ready for any contingency that may call for his aid

5 "The syces will be thus disposed of When the troop mounts, or is formed at the park, the syces of the advance party join it Those belonging to sick horses remain with their charge Two syces remain with each carriage, on the reverse flank The remaining syces keep together in a body, move with the led horses in rear of the troop, under charge of the stable orderly and jemadar syce One jemadar syce should be with the advance party, and one with the sick horses and stable gear that precedes the troop

6 "No syce must be allowed to touch the pegs or clothing of his horses until the order is given, the condition of the horse depending so materially on his being suffered to enjoy undisturbed repose Great care is requisite to prevent fires in the horse lines, which wastes the grass, and endangers somewhat the ammunition All particular orders against fires, and for the security of camp, and for arrangements and precautions during the night, when near an enemy, should be given to the European sentries, whose control over the syces must on no account be interfered with Such orders should be explained by the subaltern on stable duty to the jemadar syces, that perfect co-operation may be ensured It should be understood as a general rule that from and after a certain fixed hour at night (9 or ½ past is late enough) until the gun or warning trumpet in the morning, no baggage, animal, or person of any description is permitted to enter or quit the camp, nor is any tent or horse-pin to be touched Unless these orders are fully explained and enforced, no regularity or quiet for men or cattle can be expected

7 "After the parade call has sounded in the morning, no carts are on any account to be allowed to leave camp until the troop has marched, in order that no obstruction may be experienced at starting

8 "The men should not be permitted to mount without the order being given by the senior officer, and before doing so, sufficient time should, in all practicable cases, be allowed for the due examination of the teams, their harnessing, putting to, &c This should take place under the supervision of the subaltern officers and their sergeants After mounting, a slight pause should also be made to steady the horses, and to rectify any mistake or omission, each team must be successively moved off, all the horses working together, to ensure which the sergeants will order, *No —, Forward, March*, when all the horses of the sub-division are pressed off together By attending carefully to these points, delays and accidents, which occurring before daylight on a march, or on service, might be productive of so much

inconvenience, may readily be avoided In heavy ground, where the united efforts of the team are so essentially required, this caution becomes most important

9 " *Hurry must be avoided at all times*, not only on ordinary occasions of moving off, but even where the emergency of service appears to press A serious inconvenience may result from apparently a trifling omission —for instance, forgetting to light the slow matches, when going into action

10 " It is a very desirable plan on ordinary marches, and on service when not in the immediate vicinity of an enemy, to adopt postilion driving,* and, particularly where the roads are not very good, to put an extra pair of horses into each carriage ,—the number of men will always allow of this number being driven The information regarding the country and roads, which of course the commanding officer will have possessed himself of, will enable him readily to provide for any difficulties that might present themselves to inexperienced drivers, but in fact horses become much quieter from being handled in pairs If a very rapid stream is to be crossed, with difficult banks or ghauts, single driving could at all times be resorted to, but such cases must be decided on by the commanding officer according to the confidence he f[illegible] in the skilful driving of his [illegible]

[illegible] " In general it is not desirable [illegible] change horses on the march With [illegible]ouble sets, working them on alternate days, affords the best relief to the horses, and is more convenient A portion of spare horses will always be at hand to replace any that may become lame or overtasked

12 " Halt every 4 or 5 miles if practicable, but it is not necessary to dismount the men on each of these occasions One halt during the morning's march should be of some duration (about 20 minutes), to enable the men to refresh themselves The other halts being merely to breathe the horses, need not usually exceed a few minutes No man should be allowed to dismount except when the troop is halted

13 " Free working horses, if on the near side, may be shifted at these halts to the off Such cattle should usually be worked on the off side, but not always, since it is desirable that all the horses should readily draft in any place The wheelers should be the most powerful and most ungovernable horses in the troop

14 " Never allow any carriage or single horse to move faster than a walk, without an officer's order The leader of a column should so regulate the pace that all the horses can walk up to it To ensure this, the guns should lead alternately, forming column of route, by which means each team will lead in its turn, and the rate of each be ascertained

15 " In case of any gun or wagon falling to the rear by any accident (beyond the mere giving of a hook, strap, or other trifling cause instantly remedied), word is to be passed on to the head of the column, *No —gun in the rear*, or as the case may be, and in a similar way its rejoining the column is to be announced This is an essential precaution on service, and particularly before daylight, in passing through towns and narrow roads and defiles

16 " A feed of gram should on all

* Postilion driving is now the established system.

occasions accompany the troop, for which purpose the travelling gram-bags should be attached by a strap and buckle to the off-saddle rings It is not considered requisite here to arrange for a feed of hay during the march, as the emergency which may call for any such arrangement must be especially provided for No forage of this description can be carried on the horses or carriages, and it is very rare that horses can be fed with hay intermediately during a march, except on Rear Guard or Fatigue Duty, when separate carriage must be allotted

17 "It may sometimes be desirable to water the horses during the march, as the ground taken up for the camp may be at some distance from water, and the watering of the gun horses may be attended with risk in the vicinity of an enemy In such cases, of course, the commanding officer must be guided by circumstances, but if a good stream be found *en route*, reasonably near the camp, it will generally be prudent to let the horses drink, unless they are much heated, or there be the least prospect of active operations before the horses are at their pickets It must be always understood that when the grass-cutters cannot be sent on in advance, some mode of carrying forage must be provided A few tatto loads kept well up with the troop, afford a ready means of effecting this, and of providing the horses with some grass until more is brought in by the grass-cutters

18 "Crossing nullahs and passing difficult places require care and circumspection,—the great point is not to allow the carriages to crowd on each other, particularly in descents The intervals between the carriages must be increased according to the nature of the ground In heavy sand, every precaution must be used to prevent a check,—when once stopped in deep sand, the labor of starting a carriage is very great Never allow the men to spring their horses up an ascent without your orders It is generally best to walk steadily up, but it may occur that a short abrupt bit of hill can only be got over by springing the horses up it In such case the carriage should be moved briskly down the lower part of the descent, and galloped smartly up Never attempt to *trot* in such a case, and do not check until a level space is gained, take especial care that sufficient space is left by the leading carriages for the others in succession to gain the level ground without a check The use of the locking-chain is seldom requisite The drag ropes may be of essential service in very difficult ground where but one carriage can pass at a time They are to be manned by the syces or any available hands

19 "Officers and non-commissioned officers must direct their attention to the fair and equal drafting of the horses, that the off horses are kept up to their work, and have the bearing reins loosened in heavy ground, and when halted When the men are dismounted, the shaft props should be let down Careless riding must be immediately checked, as nothing fatigues a horse more than his rider lolling in his saddle, leaning back, or to one side, and is apt to gall them besides, sergeants should therefore not only frequently look back, but also shift their place occasionally, so as to overlook thoroughly their respective sub-divisions

20 "The carriages drawn by bullocks will not easily be kept up with the troop, but it is desirable to keep

them in view if possible, and when the road is fair and the loads light, it can generally be accomplished The drivers and train establishment will be sure to fall to the rear if allowed, and come at their own convenience, by which half the working day is usually lost, and in case of accident on the road, assistance is not at hand

21 "On arriving at the new ground, each sub-division, as it comes up to its park picket, should dismount the men, untrace horses, and file off in succession The horses will get picketed sooner, and with less confusion, than by untracing the whole troop simultaneously *

22 "The camp colorman who has preceded the troop, having planted the park pickets and laid down the horse lines, the spare syces will at once distribute the mallets (of which there should be at least two to each sub-division) and place grass for drying the horses opposite the position of each All this, on ordinary marches, should be done before the troop arrives

23 "The syces, assisted by the men, set home the head pickets, and secure the horses, then proceed to remove the harness, &c When the horses are dry and cool, send them off to water, covered with a blanket if the weather is cold After returning from water, they are to be thoroughly cleaned

24 "On ordinary marches the camp colorman and bildars will proceed on the day previous, so as to reach the new ground before dark, to fix on a good spot for encampment He will receive his orders before he sets out The ground must be selected with reference to the space required, the nature of the soil, which should neither be hard and rocky nor very loose and sandy, and in the vicinity of water Trees should be avoided, unless they are lofty and not low branched, but the *vicinity* of shady trees is desirable for the comfort of the followers, and of the men also, should their tents be delayed If no running stream or good tank is at hand, the camp colorman will cause the bildars to make troughs to wells for the horses to drink from, and hire bullocks ready to draw water for them They can generally be hired for this purpose for two annas each animal One puckaulie should go in advance with the camp colorman, to ensure a supply of water for the men and work-shops These men also generally can tell whether the water is good and fit for the purpose of watering the horses

25 "The spare grass, well ropes, buckets, mallets, and spare pegs, the grain camels, forge and store carts, the commissariat, bazar, spare tent and breakfast things of officers, leave camp under a guard and guide at a fixed hour—½ past 9 is late enough

26 "Grass cutters may be allowed to start at the 1st trumpet in the morning, so as to keep ahead of the troop, and forage by the way On service this may not be practicable

27 "The grain should be placed so that the sentry over the park may take cognizance of it, and at night, the early morning feed should be put under charge of the sentry in rear of the park, and a syce sentry especially planted over it

"NIGHT IN CAMP

1 "At sunset the sentries are posted by the officer on duty, so as to observe the camp throughout Stable duty for all men off duty, until the horses get their evening feed At

* This duty will of course be performed according to the regulations

evening stable duty, officers will tell off their teams, and make every preparation for the morrow's march, unless they have done this in the morning before the 'dismiss' was sounded The officer on duty must invariably attend this stable duty parade, and all other duties and parades during his tour

2 "With exception of the precautions for protecting the park and ammunition, the duties of an artillery camp do not differ from those of any other service As in an instant the efficiency of a troop of horse artillery might be entirely destroyed, it is obvious that too great precautions cannot be taken to guard the park, as far as possible, even from the risk of accident from fire The sentries over it should be double at night, and instructed not to allow any fire to windward of the park within 200 yards, neither are they to permit any one, with a light, or smoking, to come within the park, or near to the carriages, in case of difficulty, or if the party challenged fails to comply, the guard to be immediately called on to assist

3 "The officer on duty must be careful that the sentries well understand their orders, and he should go the rounds at uncertain hours of the night, to satisfy himself that the sentries are alert on their posts and acquainted with their duty, In the vicinity of an enemy, this is a most important duty

4 "As it is absolutely necessary for the repose of men and cattle that the peace of the camp should be preserved during the night, the syces must be required to look well to the fastening of their horses in the evening, and in the event of any horse drawing his picket peg, or getting loose, the syce attached to him should be made to secure him without noise, no driving of pegs during the night is, on any account, to be permitted

"Miscellaneous

1 "Hand-rubbing the horse's legs should not be confined merely to the time of feeding, but continued for 20 minutes three times a day

2 "Every exertion must be made to ensure a full supply of good grass, and whenever the quantity carried by the camels is broken in upon, in consequence of the grass-cutters bringing in too little for the daily consumption, the advanced or *russud* party should be instructed to lay in a supply, if difficult to be obtained, a requisition should be made on the civil authority to collect grass at any named place

3 "Take advantage of any halt to complete your stock of charcoal, pegs, mallets, &c, &c, have the wood collected by your advance party, that no time may be lost in setting the men to work on it

4 "Harness and saddlery require great care and attention on a march If a spare tent be available, protect it thus from sun and rain Have the panels of the saddles and insides of collars beaten daily, if practicable, with a small cane Officers and sergeants must frequently examine the harness and saddlery attached to their respective charges, and see that it is not changed from one horse to the other, without express order It must be frequently well rubbed with *momroghun* If a protracted halt occurs, take advantage of it to put your harness and saddlery into perfect order

5 "After a march, the 'dismiss' should not be sounded until you have received the reports from the subaltern officers of their respective charges

6 "On the march, the post of the

officer on duty is usually with the rear fighting carriage, a trumpeter should attend him

7 "Look to the collar trace linking chain to see whether a horse is working, the trace itself may be drawn straight by the horse in front

8 "The elevating screws to be kept run down and covered with woollen cloth,—to be well cleaned and examined once a week If near an enemy, uncover the screws, and fix them about line of metal elevation On ordinary relief marches, the tangent scales may be kept in the boxes with the small stores, but if there is any prospect of service, to be kept fixed in the guns In the vicinity of an enemy, keep one slow match alight on the march, and at night

9 "The limber hook and the wheels should be frequently greased Unless you have at least two days on the same ground, do not attempt to set up a wheel with your troop establishment of artificers alone All the leather-work about the carriages, the spunge straps in particular, to be well oiled at least once a fortnight, and a report made to the officer on duty of its having been done All straps to be renewed as soon as they show any signs of wear

10 "The sergeant of each sub-division, assisted by a gun lascar, should examine his ammunition every evening, and see if any of it has become loose, or if any powder dust has fallen to the bottom of the boxes, if so, to be removed and ammunition re-stowed Whilst packed sufficiently tight not to be shaken by the travelling, the shot and shell should not be so tightly jammed in by tow as not to be readily got out if required When the air is dry and clean, the cartridges should frequently be exposed to the sun, after heavy rain, or protracted damp weather, the first favourable opportunity should be taken of emptying the bags, drying them and the powder, and refilling them"

Marines—Are a body of men raised for service as soldiers on board naval ships The whole regiment is never afloat, only portions of it, the rest being stationed at some of the naval seaport towns The marines were first raised in 1664, and have been considerably strengthened since the commencement of this century The corps now possesses a marine force of artillery, which is a most effective and valuable body of men It is a non-purchase corps, so that the officers, as in the Artillery and Engineers, rise by seniority

Marks—All ordnance, with their stores, packages, &c, are marked in such a manner that either in store or on service they shall be easily distinguished, and this is absolutely necessary, considering the multifarious stores composing an artillery equipment, which, bearing a similar denomination and appearance, are easily mistaken one for the other The marks on the different natures of ordnance are to be found in Millar's Army Equipment, Part II, Artillery, and Stoney's Construction of our Heavy Guns, and the marks on ammunition in Captain Orde Browne's Treatise on Ammunition

Marline—A small line used for winding round ropes and cables

Marline Spike — An iron pointed tool, used in splicing ropes

Marquee—An awning or cover of canvas forming an officer's tent, a tent complete Marquees are of two kinds, *viz*, a dining and sleeping marquee the former used as the officers' mess tent

Marquois's Scales — The

following description is given in Heather's Treatise on Mathematical Instruments "These scales consist of a right-angled triangle, of which the hypothenuse or longest side is three times the length of the shortest, and two rectangular rules Either rule is one foot long, and has, parallel to each of its edges, two scales, one placed close to the edge, and the other immediately within this, the outer being termed the artificial, and the inner, the natural scale The divisions upon the outer scale are three times the length of those upon the inner scale, so as to bear the same proportion to each other that the longest side of the triangle bears to the shortest Each inner or natural scale is, in fact, a simply-divided scale of equal parts, having the primary divisions numbered from the left hand to the right throughout the whole extent of the rule The first primary division on the left hand is sub-divided into ten equal parts, and the number of these sub-divisions in an inch is marked underneath the scales, and gives it its name In the artificial scales, the zero point is placed in the middle of the edge of the rule, and the primary divisions are numbered both ways from this point to the two ends of the rule, and are, every one, sub-divided into ten equal parts, each of which is, consequently, three times the length of a sub-division of the corresponding natural scale"

Marroons—Decorations for rockets They are cubes filled with grained powder, and enveloped with two or three layers of strong twine or marline , to give them more consistency they are dipped in kit, they are primed by punching a small hole in one corner and inserting quick match

Marshal—This term was originally applied to an officer in charge of horses, being derived from the old German *mahre*, a horse, and *schalp*, a servant Now-a-days it has a very different signification, the term being applied in military life to an officer of very high rank (*Vide* Field Marshal)

Martello Towers—The name given to the circular towers built along different parts of our coast, and which were erected at the commencement of the present century to ward off the meditated invasion of Napoleon Some of them have since been dismantled, and others strengthened and armed with heavier ordnance The name is stated to be derived from a fort in Martello Bay, Corsica, which was captured by the British in 1794 According to Brande and Cox, these towers are provided with vaulted roofs, and consist of two stories, the lower for stores, and the upper, which is shell proof, for the accommodation of troops, and the wall of the building terminates in a parapet, intended to secure the men in working the guns These are mounted on traversing platforms, so as to be fired in any direction

Martial Law — According to the Duke of Wellington, is neither more nor less than the will of the general that commands the army In fact, martial law means no law at all, therefore the general who declares it and commands that it shall be carried into execution, is bound to lay down the rules, regulations, and limits, according to which his will is to be carried out

The effect of a proclamation of martial law in a district of England is a notice to the inhabitants that the Executive Government has taken upon itself the responsibility of superseding the jurisdiction of all the ordinary tribunals for the protection of life, person, and property, and has authorised the

military authorities to do whatever they think expedient for the public safety (Pipon's Manual of Law) It would be an extreme measure to resort to martial law, and then only in case of great danger and necessity

Martinet—A term applied to a strict disciplinarian It is supposed to have taken its origin from an adjutant of that name, who was in high repute in the French army as a drill officer during the reign of Louis XIV

Martini-Henry Rifle — A rifle lately introduced into the British Army to supersede the Snider-Enfield, the arm hitherto of the service

It may not be uninteresting to the reader to know the circumstances under which the change from muzzle-loading small-arms to breech-loaders took place

In July 1864, a committee on small-arms was appointed by Government, which recommended that it would be desirable to arm the British soldier for the future with a breech-loading rifle The question then was as to the means of carrying out the recommendation It was suggested that the Enfield rifle should be converted pending the more important question of a totally new arm for the service It was proposed also at the same time that, in the conversion of the Enfield rifle, the principle of separating the shooting part of the gun—*viz*, the barrel—from the loading part, or breech, should be distinct questions, and upon this principle was settled the conversion alluded to, which guided the Government ultimately in its selection of the Martini-Henry Rifle

The question of conversion having been settled and having proved satisfactory, it enabled the Government to take its own time in maturing a new arm, which intention, notwithstanding the conversion of the Enfield, was not lost sight of

As is well known to all soldiers, the Snider-Enfield rifle proved a success, and was pronounced by the breech-loading committee "a most efficient military weapon" The cartridge (Boxer's) also proved satisfactory, upon which, as Captain Majendie observes, "the success of the system must in a great measure hinge" But from further experience derived in the handling of the converted weapon, it was found that the Snider breech-loading apparatus had this defect, *viz*, that the breech was not secure in the event of explosion, for though no very heavy percentage of casualties had occurred from this cause, there had been sufficient to illustrate the disadvantage of a non-safety breech

Notwithstanding this imperfection, the Snider breech-loader would probably have remained the service arm of the British soldier, "could it," as Captain Majendie observes, "have held its own against the numerous improvements of an active age" But as he further remarks "Was it reasonable to expect that the ingenuity which for some years has been concentrated upon the production of a good breech-loader, could suggest no improvement in an arm of which the breech action (which, moreover, was hampered with the condition of its application to existing arms) was adopted in 1866, before the period of unexampled activity in this direction, and of which the shooting apparatus had been adopted in 1853, sixteen years ago?"

It having been determined, therefore, that a new breech-loader should be introduced into the service, possessing the conditions required by the committee,—*viz*, accuracy, low trajectory, and non-liability to fouling, with the great-

est perfection and simplicity of breech apparatus,—the Government offered a reward for the best rifle and cartridge; a large number of arms were submitted by various inventors for competition, which resulted in the Martini and Henry rifles being considered as the arms best answering the conditions required. But in the exposure test, it was found that the Martini mechanism had slightly the advantage of the Henry, but the rifling of the latter was accepted as the "most suitable in all respects for the requirements of the service" Thus it came to pass that an alliance was made between the Henry-barrel and the Martini-breech to give us the arm of the future, and this was recommended by the committee.

The trials made with this rifle show incontestibly that we have got an arm which at 500 yards is 25 per cent better than the Snider, and which, as regards rapidity, can fire 25 shots a minute Some trials have been also made between the Martini-Henry and Chassepôt rifles, resulting largely in favor of the former.

The following explanation of the form of rifling, and the particulars as to the breech mechanism of the new weapon, is taken from Captain Majendie's lecture on this arm —

"The Henry rifling is a polygonal system of nine or seven sides, the latter having been adopted in the new arm The angles are broken by ribs, which create re-entering angles, the inscribing circle tangential to the ribs being described with the same radius as the inscribing circle tangent to the plane sides The twist is 1 in 22, uniform

"The breech mechanism consists briefly of a swinging block hinged upon a pin passing through its rear end, the recoil being taken by the shoe The cartridge (Boxer's) is exploded by a direct-acting piston, which is driven by the action of a strong spiral spring within the breech-block The block is moved by means of a lever to the rear of the trigger guard The motion of pushing the lever forward depresses the block, compresses the spring, and rejects the empty cartridge case When the lever is drawn back, the block is raised and the breech closed, the arm remaining cocked If desired, the safety bolt can now be employed to secure the gun from going off There is also an indicator at the side to show if the arm is cocked or not

"The cartridge is the Boxer, the bullet is Mr Henry's The weight is 480 grains Weight of powder, 85 grains Maximum diameter equal to that of the bore, 45"

While this work has been passing through the press, information has been received of a competitive trial having taken place between the Martini-Henry, Snider, and Chassepôt rifles, and the Prussian needle-gun, the result of which shows the Martini-Henry to be the superior weapon, which is satisfactory to the English Government after the anxiety, expense, and trouble which has been taken to procure the best weapon for the British Army

Martin's Shell—Is a shell of peculiar construction, used as a substitute for red-hot shot in firing against shipping The interior of the shell is coated with some non-conducting substance, such as clay and hair, to separate the molten iron with which the shell is filled, previous to firing, from the metal of the shell It is intended that the shell on striking the side of the vessel should be broken by the impact of the molten iron upon the interior surface, and the heated

metal being thus released produce conflagration Also should it penetrate through the side of the vessel, it would, no doubt, inflict most terrible wounds upon the men between decks A small cupola furnace is required for heating the metal, a ton of which is melted in about 30 minutes

The cupola is a wrought-iron case with fire-brick lining, and moulding sand on the bottom and mouth The shell is filled bottom on A few blows from the hammer form the metal round the fuze hole The shell is brought up on a bearer, bottom up

The shells are lined with loam They must be perfectly dry inside

Martingale — A thong of leather, fastened at the end of the girths under the belly of a horse and at the other end to the musral, to keep him from rearing

Masked—This term is applied to batteries that are hidden or concealed for the purpose of opening upon the enemy unawares

Mass—The mass of a body, or the quantity of matter of which it consists, is the collection of atoms or molecules which compose it These atoms or molecules, not being in actual contact, are capable of compression and being forced into less dimensions, and a body is either termed porous or dense according to the closeness or otherwise of the atoms that form the mass , thus wood is said to be porous, a cannon-shot dense

The *mass* of a body is the quotient of its weight divided by g thus $w = m\ g$ where $w =$ weight, $m =$ mass

Master Gunner—A warrant officer selected from the non-commissioned officers of artillery, whose duty it is to take charge of guns, ammunition, stores, &c , in fortresses

Mastic — A resinous substance which exudes in the form of tears from the *Pistacia lentiscus* It is a valuable ingredient in several varnishes, and dissolves either in spirits of wine or oil of turpentine without the aid of heat To form the varnish, take three pounds of mastic to a gallon of oil of turpentine, strain it after agitation, pour it into a bottle loosely corked, and expose it to the sun and air for a few weeks It makes a good varnish for painting What is termed Indian mastic is composed of lime (made from shells), oil, and pitch, and is used in India for paying ships' bottoms

Match—There are two kinds of match familiar to the artilleryman, quick and slow match Quick match is made of different sized threads,—*viz* , four, six, and ten thread,—soaked in a solution of gunpowder, mixed with gum arabic and water in a boiling state, and of such a consistency that the thread shall be thoroughly coated with it , it is then wound on the reels, and gunpowder sifted on it If it is stiff, and has the coating of powder perfect over the surface, it is serviceable If it has been bruised or twisted, and the coating of powder removed, it is unserviceable Slow match is made of slightly twisted hempen rope, soaked in lime-water and saltpetre, and then dried

Matchlock—The ancient term for a small-arm or firelock It is fired by a match, hence its name

Materials—In this term is comprehended, in artillery, the wood and iron work used in the construction of ordnance carriages, stores, &c Under the head of "Timber" is shown the wood used, and where produced, in the manufacture, hitherto, of our Indian carriages

Materiel—The name given to the arms, ammunition, baggage, stores,

implements, and horses, &c, of an army, or of any constituent part of it

Mathematics—A science which teaches to number and measure whatever is capable of it, comprised under lines, numbers, superficies, or solids

Matrix—Metallic ores are usually associated with stony substances, which form what is called the *matrix* or *gangue* The mould used in type-founding is also called the *matrix*

Matross — A name formerly given to an artilleryman In the early organisation of the British Artillery, there were only two trained artillerymen per gun, they consisted of a gunner and his mate, or matross

Matter—Every thing which has weight is called *matter*, and a body is a portion of matter limited in every direction The quantity of matter in a body is called its *mass*, and is measured by its weight

Mattock—A tool resembling a pick-axe, having a pick on one side, and a hoe on the other

Maul—*Vide* Mallet

Maund — An Indian weight of 40 seers, or 3,200 tolahs It is also equal to 100 lbs troy or 82$\frac{2}{7}$ avoirdupois This is termed the *bazar* maund In commerce, however, the *factory* as well as the *bazar* maund is used, which is equal to 74 lbs 10$\frac{2}{3}$ oz avoirdupois

Maximum Charge — One-third the weight of the ball is the maximum charge that should be used with smooth-bored ordnance, anything above this only creates inconvenient recoil, and great strain to the gun and carriage

Maximum Range—In gunnery, expresses the extreme range of a projectile either in *vacuo* or in the air In the former, with a given velocity, the extreme range of a spherical projectile would be obtained at an angle of 45°, in the latter, with a velocity of 1,600 feet per second, the maximum range would be obtained at an angle of about 32°, a 56 lb shot would, under these circumstances, at 32°, range 5,720 yards in the air, and 23,946 yards in *vacuo*, and at 45°, 26,666 yards in *vacuo* The maximum range of rifled ordnance is much in excess of what is shown above, the 9-inch gun having ranged over 11,000 yards

Mean—As a general term, implies the medium between two extremes, and is ordinarily understood to be what is known in mathematics as an arithmetic mean An arithmetic mean between two numbers is found by adding them together and dividing by two A geometric mean is found by dividing the larger number by the smaller, and taking the square root, which gives the common ratio, the smaller number multiplied by this ratio, or the greater number divided by it, gives the mean A harmonic mean is found by adding the reciprocals of the numbers and dividing by two, the reciprocal of the result is the mean

Measure of Precision—An expression made use of in gunnery, in comparing the regularity or otherwise of the initial velocity of service projectiles fired from service guns with service charges B L rifled guns, in consequence of the absence of windage, have the greatest regularity; smooth-bore guns, as might be expected, the greatest irregularity

Measure of Uniformity—In gunnery, denotes the regularity in the velocity given by a number of consecutive rounds It is calculated as follows Take the mean observed velocity, and from this deduct the difference of each round, and divide the

sum of the differences by the number of rounds fired

Measurement of Ordnance—

1 All service cast-iron and brass ordnance (smooth-bore) are to be measured from behind the base ring to the face of the muzzle

2 All muzzle-loading rifled, or smooth-bore wrought-iron ordnance without base rings, are to be measured from the neck of the cascable to the face of the muzzle

3 All breech-loading guns (either screw or wedge) are to be measured from behind the breech to the face of the muzzle, taking in, therefore, the total length of the construction, not, however, including any part that can be detached—as a breech screw

4 All guns with attached breech pieces, or screws, are to be measured from the end of such screws when screwed up, to the face of the muzzle, exclusive of the handle or lever, if any

Measurement of Timber—The following rule is to be pursued for round timber Multiply the length by the square of one-fourth the mean girth for the solid contents, or $\frac{LC^2}{16}$, L being the length of the log, and C half the sum of the circumferences of the two ends Sawed or hewn timber is measured by the cubic foot, or more commonly by *board measure*, the unit of which is a superficial foot of a board one inch thick

Measurement of Shipping for Tonnage—This must be ascertained while the hold of the vessel is clear The calculation of tonnage for baggage, stores, &c, is by measurement, a ton consisting of 40 cubic feet, but metals and very heavy articles are estimated by actual weight without reference to the bulk The following is the rule for ascertaining the tonnage, as given in the Artillerist's Manual —

"*Rule*—Divide the length of the upper deck, between the after part of the stem and the fore part of the stern post, into six equal parts

"*Depths*—At the foremost, the middle, and the aftermost of those points of division, measure in feet and decimal parts of a foot, the depth from the under side of the upper deck to the ceiling at the limber strake In the case of a break in the upper deck, the depths are to be measured from a line stretched in continuation of the deck

"*Breadths*—Divide each of those three depths into five equal parts, and measure the inside breadths at the following points, *viz*, at one-fifth and at four-fifths from the upper deck of the foremost and aftermost depths, and at two-fifths and four-fifths from the upper deck of the midship depth

"*Length*—At half the midship depth, measure the length of the vessel from the after part of the stem to the fore part of the sternpost, then to twice the midship depth add the foremost and the aftermost depths for the sum of the depths, add together the upper and lower breadths at the foremost division, three times the upper breadth, the lower breadth at the midship division and the upper and twice the lower breadth at the after division for the sum of the breadths, then multiply the sum of the depths by the sum of the breadths, and this product by the length, and divide the final product by 3,500, which will give the number of tons for register

"If the vessel have a poop or half deck, or a break in the upper deck, measure the inside mean length, breadth, and height of such part there-

of as may be included within the bulkhead, multiply these three measurements together, and dividing the product by 92 4, the quotient will be the number of tons to be added to the result as above found

In order to ascertain the tonnage of open vessels, the depths are to be measured from the upper edge of the upper strake

"*To ascertain the Tonnage of Steam-vessels*

"*Rule* —In addition to the foregoing rules, when applied for the purpose of ascertaining the tonnage of any ship or vessel propelled by steam, the tonnage due to the cubical content of the engine-room must be deducted from the total tonnage of the vessel, as determined by either of the rules aforesaid, and the remainder will be the true register tonnage of the said ship or vessel

"*To determine the Tonnage due to the cubical content of the Engine-room*

"*Rule* —Measure the inside length of the engine-room in feet and decimal parts of a foot, from the foremost to the aftermost bulkhead, then multiply the said length by the depth of the ship or vessel at the midship division as aforesaid, and the product by the inside breadth of the same division at two-fifths of the depth from the deck, taken aforesaid, and divide the last product by 92 4, and the quotient will be the tonnage due to the cubical content of the engine-room"

Measuring Chain—In surveying, consists of 100 links, or 22 yards, this is the English length, seldom used in India, where the 100-feet chain is the most common

Mechanical Manœuvres—Include all such mechanical appliances as are used in the mounting and dismounting and moving of heavy ordnance, the mode of applying which will be found in the Manual of Artillery Exercises

Mechanical Powers—Are contrivances by which we are enabled to sustain a great weight or overcome a great resistance by a force

Mechanics — That branch of mathematics which treats of motion, and develops the effects of powers or moving forces, so far as they are applied to engines

Medical Department—Consists of the following a. Director-General, who ranks as a Major-General, Inspector-General, as a Brigadier-General, or after three years' full pay service, as a Major-General, Deputy Inspector-General, as a Lieutenant-Colonel, or after five years' full pay service, as Colonel, Staff or Regimental Surgeon (but junior of the rank), as a Major, Staff or Regimental Assistant Surgeon, as Lieutenant, and Captain after six years' full pay service

Medium—In gunnery, expresses the elastic fluid through which a projectile, after leaving the piece, has to pursue its course, termed the "resisting medium"

Melting Point—In metals, that degree of heat when fusion commences, which, with those undermentioned, is as follows

	Faht
Iron and platinum melt at about	3300
Cast iron	2786
Copper	1996
Antimony .	800
Zinc .	773
Lead	612
Tin	442

Mensuration—Is that branch of practical geometry which teaches the methods of calculating the dimen-

sions and areas of figures, the volumes of solids, &c, from the measurement of certain lines or angles of the figure or solids, which supply the requisite data

Mercury ($Hg100$) — Is a substance which has only of late years been raised to the dignity of a metal, from the idea that it could not be solidified, and was looked upon as an imperfect or semi-metal, containing a principle regarded as pure vitrifiable earth,—silica of modern times In 1859, the knowledge that it could be solidified acquired by the academicians of St Petersburgh, was first the means of removing the notion of its semi-metallic nature, and inducing inquiries by several learned chemists, which led to its being recognised as a true metal Its fluidity at all ordinary temperatures, coupled with its silvery whiteness and metallic lustre, gave it the popular name of quicksilver It was known long before the Christian era, and the Spanish mines at that period yielded large supplies It is found still in Spain, but other countries yield it, *viz*, Hungary, Sweden, Peru, New Granada, Mexico, California, and China With reference to its properties, it is fluid at all temperatures between 39°5 Fahr and its boiling point, which is somewhere about 670° or 680° It solidifies at — 40°, and in this state permits of being beaten out under the hammer, welded, &c, like other metals Mercury is used in artillery laboratories in the preparation of "fulminate of mercury," for percussion caps, and in taking the density of gunpowder Its specific gravity is 13 586, at a temperature of 75° (*Vide* Fulminate)

Spherical shot are floated in mercury to ascertain whether they are homogeneous, and if so, should rest indifferently in any position in the mercury

Meridians—Are imaginary great circles passing through the terrestrial and celestial poles, cutting the equator and equinoctial at right angles A meridian is supposed to pass through every place on the earth and every point in the heavens, but only 24 are drawn on the globes, through every 15° of the equator and equinoctial, including altogether 360° The meridians mark the space which, in consequence of the earth's diurnal rotation, the heavenly bodies appear to describe every hour through the 24 in the day They are sometimes called, therefore, hour or horary circles As 15° answer to an hour, 1° answers to four minutes of time, ½° to two minutes, and ¼° to one minute

Merlon—In fortification, is that portion of the parapet contained between two embrasures, it is generally from fifteen to eighteen feet in length

Mess—In the British Army, a regimental institution for the maintenance of a common table for all the unmarried officers in a regiment Its introduction into the British Army has been attended with the happiest results, admitting of officers of all ranks meeting together on an equal social footing, whereby the youngest officer in the regiment is able to enjoy the society of his senior and brother officers without reserve The advantages of a mess are manifold, and are seen not only in its social value, but also in the means it offers to all ranks of living well and economically, and suitably to the pay of all grades Messes are extended also to the non-commissioned officers and men of a regiment, who have their several messes under the superintendence of the officer commanding the regiment and the captains of companies

Metal-lined Cases — Are powder barrels lined with sheet copper

for the purpose of holding prepared cartridges

Metal-lined cases are used as portable magazines When tested they should be perfectly water-tight

Metallurgy—The art of working metals and separating them from their ores

Metals—Are elementary bodies capable of combining with oxygen, and many of them, during this combination, exhibit the phenomenon of combustion Metals are distinguished by their great specific gravity, considerable tenacity, hardness, opacity, and property of reflecting the greater part of the light which falls on their surface, giving rise to metallic lustre or brilliancy

Methylated Spirits — Consist of alcohol (C^4 H_6 O, HO) of specific gravity 83, mixed with 10 per cent of wood spirit, or methylic alcohol (C^2 H_3 O, HO), which is one of the products of the destructive distillation of wood

Metre — The French unit of length, equal to 39 371 inches

Micrometer—An instrument for measuring very minute spaces, the thousandth part of an inch being correctly ascertained by it

Middle—In preparing a fuze, to fix the quick match and priming in the cup of the fuze

Mile—The length of the geographical mile varies in different countries The geometrical mile consists of 1,000 geometrical paces The English geographical mile=1,760 yards, or 69¼ miles to a degree

Military—Anything pertaining to the soldiery The word comes originally from *miles*, a soldier The French term *militaire* is used to signify any individual who bears arms for his country or belongs to the profession

Military Finance—A departpartment of the army which regulates every military expenditure Upon this department devolves the close scrutiny and inspection of all accounts, the revising of all estimates, periodical or otherwise This department also furnishes to Government every explanation as to the necessity of any particular expenditure to be incurred It may be said to be one of the most important departments of the army

Military Law—Is a code which, formed for the guidance of a particular class of the community,—the standing army,—exists side by side with the common and statute law of the land, and its tribunals exercise their functions independently of, and yet in harmony with, the ordinary courts of justice, with which they do not, and cannot interfere

Military Telegraphy —The adaptation of the electric telegraph to the purposes of warfare has been a source of great advantage on armies taking the field The object of such an organisation will be apparent to all who consider the subject, which is nothing less than enabling the different *corps d'armées*, or divisions of an army, to communicate with their Commander-in-Chief, and with each other, in a few minutes, over distances which, under ordinary circumstances, could not be accomplished without hours of hard riding The Prussians in their campaign against the Austrians appear to have had a well-organised field telegraph In India, during the mutiny of 1857, the late Lieutenant-Colonel Stewart, R E, brought the field telegraph into operation with great advantage It appears from a lecture given at the United Service Institution by Captain Stothert, R E, in May 1870, which is well worthy of perusal, that

telegraphs for warlike purposes are divided into classes—

1*st*—As applied to a permanent fortress

2*nd*—As required for service with an army in the field

As regards the first case there appears to be nothing very special in the system of electric telegraphs required for the purposes of a permanent fortress The great object is the rapid transmission of messages from some convenient central point, at which the officer in command would establish his head-quarters, with certain points to be selected on the several permanent lines of defence ,. 2*nd*, communication with out-works , and 3*rd*, in the case of a sea fortress, the capability of communicating with shipping This latter must be done by means of semaphores, or visual signalling, in connection with the electric telegraph

In the application of telegraphy for military purposes in the field, the objects to be attained, as described by Captain Stothert, are as follows —

"1*st*—A communication with the base of operations, which would form the main line, from which all else should radiate,

"2*nd*—The extension of this main line of telegraph, so as to keep up with the daily advance of an army ,

"3*rd*—The establishment of telegraphic communications, with a force detached for a special duty ,

"4*th*—The establishment of telegraphic communications from the centre to the flanks of an army in position ,

"5*th*—The connection of the outposts of an army, by means of visual signalling, with the terminal points of the electrical part of the system , and

"6*th*—The means of communicating with facility with a co-operating naval force"

In describing the value of visual telegraphy in connection with the electric telegraph, Captain Stothert says "We have found by practice that the most perfect system of telegraphy for military purposes is that in which the electric telegraph has been combined with visual signalling, the latter forming a most important adjunct to, and extension of, the former, and this is equally the case whether applied to the requirements of a permanent fortress, or adopted for service with an army in the field In either case, the electric without the visual, or the visual without the electric system, is bereft of half its utility and efficiency" It appears that the field telegraph can be laid as quickly as an army marches

Military Train—A corps raised after the Crimean war for the purpose of performing the transport duties of an army during a campaign The regiment ranks before the Foot Guards and immediately after the Engineers

Militia—A force raised by ballot for the permanent defence of the country This force was originally raised under Anglo-Saxon laws, and was organised in the reign of Henry II, in 1154 The militia is subject to the Articles of War during the period of training and embodiment They do not leave the country except voluntarily From recent intelligence, the militia is likely to undergo a thorough reorganisation, with reference to the mode of officering the force

Millar's Shell Guns—Introduced into the service by General Millar in 1827 The thickness of metal at the breech is considerable, and comparatively slight in the chase They are of two natures, the 8 and 10-inch The 10-in has a charge of about one-seventh the weight of its shell, and the 8-in. about one-sixth , in the 10-in

there is about 1 cwt of metal to 1 lb. of shell, in the 8-in (65 cwt) about 145 lbs to 1 lb of shell Besides the above guns, General Millar also introduced the 10-inch and 8-inch iron howitzers and the present L S iron mortars

Mills, Powder—The buildings in which gunpowder is manufactured They consist of the following charcoal, mixing, incorporating, bruising, or breaking-down, press, granulating, dusting, glazing, and drying houses

Mines—Are excavations made in the earth or solid rock, in which gunpowder or gun-cotton is placed and fired, for the purpose of rending and loosening the surrounding soil This method is commonly resorted to in quarries and such-like soils, and is known as civil mining, in contradistinction to military mining, which takes place at less depth in the ground, and is carried on in a somewhat different method In military mining the object is obtained by sinking a shaft, and running a gallery from the bottom of the shaft in whatever direction it may be required Shafts are sunk by means of frames of wood composed of pieces, two of which are long and two short, the sides being supported either wholly or partially by wooden lining, on arriving at the necessary depth, the excavation, now termed the gallery, is carried on in a horizontal or inclining direction, the miner supporting the top and sides of his excavation with wooden linings, unless the soil should prove of sufficient tenacity to require only the top of the gallery to be supported Small galleries run out from the main gallery are termed branches, when their dimensions are under 3 feet by 4

The annexed table as laid down in the Aide Memoire, gives the names and dimensions of galleries and branches employed in mining operations

Name of Gallery or Branch	Dimensions in the clear Height Width	Scantling of Frames: Ground Sill	Scantling of Frames: Stanchions	Scantling of Frames: Cap Sill
	Ft In Ft In	Inches	Inches	Inches
1 Great Gallery	6 6 × 7 0	6 × 3	6 × 6	6 × 8½
2 Principal Gallery	6 6 × 3 9	5½ × 3	5½ × 5½	5½ × 8
3 Common Gallery	4 6 × 3 0		5 5	5 × 6½
4 Great Branch	3 6 × 2 6		4 4	4 × 5
5 Small Branch	2 6 × 2 0		3 × 3	3 × 4

1 Are galleries used for descent into ditches, and the passage of cannon

2 Are used for descent into ditches, and the passage of troops, two deep

3 Sufficiently large for all the general purposes of attack, and as it allows the miner a free change of posture, either to work kneeling on both knees, or on one knee, with the right or left foot advanced, he works without feeling cramped, and executes this size more rapidly than any other

4 & 5 Too small to work in for a greater distance than 10 or 12 feet

For the charges of mines, the following rules can be taken in computing the quantity of powder necessary to raise a given volume of the earth, as, for example, a cubic yard This quantity will vary according to the weight and tenacity of the soil, but when ascertained by experiment, the rule for determining the charge is obvious, *viz*, to take $\frac{11}{6}$ of the cube of the line of least resistance for the volume, then multiply the result so obtained (reduced to cubic yards) by the quantity of powder required to raise one cubic yard, this latter quantity being under different circumstances of soil variable But in ground of ordinary weight and tenacity, it has been found that by taking $\frac{1}{10}$th of the cube of the line of least resistance in feet, the proper charge of powder for common mines is given in pounds The line drawn from the charge perpendicular to the surface is called the "line of least resistance" For further information on the subject of mining, *vide* Aide Memoire

Minim — The sixtieth part of a fluid drachm

Minute—A measure of time, the sixtieth part of an hour, a measure of an angle, the sixtieth part of a degree of a circle

Minute Guns—Guns fired every minute, either as a signal of distress, or on the death of an officer of rank, or of some high personage of the realm

Minutes—A brief report of the proceedings of a Society or Council drawn up by the Secretary For instance, the minutes of the Governor-General of India in Council, which convey the wishes and orders of Government, and which are forwarded to the different departments concerned, or published for general information

Mirror—That used in the Artillery service is a small circular looking-glass for examining the bores of guns

Missile—A projectile, or a weapon that is thrown by the hand, by the cross-bow, &c

Mitrailleur — As described by Major Fosberry, V C, of the Bengal Staff Corps, is a machine gun intended to throw "mitraille," that is, groups of small projectiles, independently, to distances of 1,000 yards, to be used against troops under certain circumstances, and to replace shrapnel

There are several types of this machine, but the one to be described is the Montigny

The Montigny consists of thirty-seven rifled steel barrels, hexagonally formed exteriorly, and fitted and soldered into a wrought-iron tube somewhat in the form of an ordinary piece of artillery, this has a movable breech-piece, worked by means of a lever, and containing a spring and striker, corresponding with each barrel The whole of the barrels can be charged simultaneously by the introduction of a steel plate containing the thirty-seven cartridges, they can be fired independently, and at any interval of time, or the whole may be fired in one second, reloading takes five seconds, and a continuous fire at the rate of ten discharges per minute can be maintained

The gun is provided with both vertical and horizontal adjustments, and may be made to sweep horizontally along a line of adjustment between each discharge, or during the discharge itself As there is no recoil, the gun once laid will continue to throw 28 lbs weight of projectiles per minute on the same spot, or at various points of any line requiring the same elevation without any further labour than that

involved in the working of the lateral adjustment It appears from Major Fosbery's account, who was sent to Belgium by the English Government to report on this mitrailleur, that at 866 yards the hits were 33 12 per cent

Major Fosbery does not recommend the mitrailleur as a substitute for artillery, but as an addition to the proper complement of that arm in the field, for the defence of roads, bridges, and defiles, for the attack of mountain passes, for flanking short faces of works, for protecting decks of iron-clads, or in dealing with an enemy unprovided with artillery He is further of opinion that for such uses we should seek in vain elsewhere for a weapon which, weighing only 397 lbs, and requiring only two men, will prove so destructive It would be specially useful in India

Since the above was written, the use of mitrailleuses has been prominently brought before the public in the war between the French and Prussians, and they are stated to have been very destructive

From the report of the Special Committee appointed to carry out comparative experiments with the Montigny and Gatling mitrailleur, it appears that the result is in favour of the latter In a special competition between this gun and the Montigny mitrailleur of 37 barrels, the former made 618 hits in 3 minutes 31 seconds, in 720 rounds at 600 yards, the Montigny, at the same range and with the same number of rounds, scoring 538 in four minutes With 558 rounds at 800 yards the result was even more favourable to the Gatling, which made 439 hits in 2 minutes 26 seconds, against the Montigny's 292 in 3 minutes 3 seconds The committee have recommended the introduction of the small Gatling battery, which has only ten barrels, to throw a 45-inch bullet with 85 grains of powder, which is the same cartridge used for the Martini-Henry rifle

Mitre-Wheel—A wheel having teeth, formed so as to work at an angle of 45° to the centre line of the shaft on which it is fixed, to move with another wheel of equal size fixed on a shaft at right angles to the former one.

Mix — In the manufacture of gunpowder, "mixing the ingredients," after they have been weighed, and previous to submitting them to the incorporating mill, is a very necessary process, it is performed by putting the composition into a cylindrical gun-metal or copper drum about 2 feet in diameter, with an axle passing through its centre, on which there are metal flyers like forks, the machinery is so arranged that the flyers and drum revolve in opposite directions, when in motion, at a rate of about 100 revolutions per minute, 5 minutes is sufficient for a thorough mixture, the composition is then drawn off by a slip into canvas bags, capable of holding 50lb charges, which are tightly tied, and taken to small magazines, these are called "green charges," and are now ready for the next process, that of incorporation

Mixing—All laboratory compositions may be included under three denominations Dry, or those which require only the simple mixture of the ingredients Wet, or those in which a liquid is used in mixing, whether as a necessary ingredient, or to give consistency to the dry portions, and those which require the application of heat to reduce all or some of the ingredients to a fluid or moist state, to admit of their mixing with the rest The following is the process pursued in each state

Dry Composition—The ingredients of all compositions which are to be mixed dry, must be each separately mealed, and after being correctly weighed, are to be well mixed together by the hand, or wooden mixer, and passed as often as is necessary through sieves of the requisite degree of fineness, fitted with leathern tops and receivers, which will prevent any of the finer particles escaping to the injury of the composition

Wet Composition — The ingredients being mealed and correctly weighed, are to be mixed well together by first pouring the liquids together into a proper vessel, and then adding the dry by small quantities, stirring the composition all the time to prevent its forming into lumps

Composition that requires Heat—If grease enter into the composition, it is first put into the boiler on the fire, to prevent the other ingredients sticking to the sides and bottom, if none be included, still a small quantity should be rubbed over the side and bottom for the above-mentioned purpose, and the other ingredients are to be added by handsful, through a cylindrical funnel, for the safety of those employed in the preparation of the composition, care being taken that the masses of the materials to be used are kept at such a distance that, should the portion in the boiler take fire, they would be safe If gunpowder enters into the composition, the boiler should be taken off the fire while the powder is being added Sulphur requires to be constantly stirred, or it will cake on the sides and take fire, in fact, all compositions should be well stirred while melting or mixing With these precautions, little danger is to be apprehended, though in spite of them, ignition will sometimes occur. When it happens, the lid of the boiler, which should fit close, and always be at hand, must be quickly placed on it to smother the fire

Moat—A wet or dry ditch, dug round the walls of a town or fortified place

Model — In casting ordnance, a model or pattern of the gun to be cast is necessary, and should be made of one or several pieces, according to the form of the mould required When the form is such that the whole model can be withdrawn from the soil at once without injuring the mould, a single piece will suffice, but generally the model is composed of several pieces, so fitted that they may be put together in succession as the moulding progresses, and finally taken apart and removed by piece-meal, when it is complete Models are made of wood and iron, the latter are preferred on account of the greater smoothness which can be given to their surface, and the greater ease with which they may be extracted from the moulds

Molecules—The infinitely small material particles, of which bodies are conceived to be aggregations

Molten Iron—Iron in a state of fusion

Mom-Roghun — The Indian name of a composition used for preserving harness and furniture It consists of two parts bees'-wax, two parts sweet oil or mutton fat, one part turpentine, and a very small quantity of camphor

Momentum—The "momentum" of a body is the product of its velocity and quantity of matter, which last is in the compound ratio of its density and magnitude Let M be the momentum of a body, W its quantity of matter or weight, and v its velocity, then

$$M=Wv, \text{ whence } W=\frac{M}{v} \text{ and } v=\frac{W}{M}$$

Thus, if a body weighing 20 lbs moves with a velocity of 6 feet per second, then $M=Wv=20\times 6=120$ feet momentum

Monk—A piece of junk or touch-wood laid over the priming of a mine to give the miner time to retire

Monk's Guns—Pieces of ordnance cast upon a principle which was brought forward by Mr Monk in 1838, which consists in maintaining the proportion which the weight of metal in a gun should bear to that of the shot (about 1¾ cwt in the gun to each pound in the weight of the shot), at the same time increasing the thickness of the metal round the cylinder of the charge, and diminishing it in the chase Some 42-Pr and 56-Pr guns were cast in 1838 upon his principle, which, however, were never extensively cast, and are now obsolete He designed also the 32-Prs known as the A, B, and C Monk guns

Monkey—A heavy weight dropped from a pile-driving machine

Moorsom's Fuze — A percussion fuze, made of metal (brass or bronze), and screwed into the shell (naval) like the ordinary naval fuze It has within it three cylindrical chambers, in each of which is a hammer of brass, suspended on a copper wire, and one or two caps containing detonating composition The two upper chambers are arranged in a similar manner, and cross each other at right angles A small channel is perforated through each cap to serve as a communication for the gas from the priming into the interior of the shell The action of the fuze is as follows the copper wires are broken by the shock of the discharge of the gun, and the hammers are then released and allowed to slide in the chambers, when the shell strikes any hard substance, one or more of the hammers will come violently in contact with their respective caps, and explode the shell The reason for having three chambers is to insure the ignition of the fuze whatever part of the shell strikes the object This fuze has been superseded by Pettman's fuze, in consequence of its liability to burst prematurely when fired with full service charges.

Mortar — A short piece of ordnance made of cast iron or bronze, and having the trunnions in rear of the breech The bores of bronze mortars are from one and a half to two calibres in length, iron mortars being about two calibres, and the shape of the chamber a truncated cone or gomer shape, named after a French Artillery Marshal of that name Mortars were used by the Turks at the siege of Rhodes in 1522, and introduced into the French Artillery in 1634, and were first used afloat by them in 1679, at the French attack on Algiers, they were then discharged from a bomb ketch, precisely as at the present time, the ketch rig was invented then, and is continued without change The object of this shaped piece is to throw shells at high angles, generally 45°, for the purpose of bombarding towns, forts, or works of any kind, which, from their penetrating power in consequence of the high angles at which they are fired, are most effective, they are also valuable in setting fire to any combustible matter amidst which they may fall, and when carcasses are used, the destruction is very great on falling into dock-yards, arsenals, powder magazines, &c

The iron mortars used for land service are the

13-inch of 36 cwt
10-inch of 18 cwt
8-inch of 9 cwt

Bronze mortars—

5½-inch royal of 1¼ cwt

4⅖-inch royal of ¾ cwt

Iron mortars are used for garrisons, siege trains, &c, and the 8-inch mortar now forms a part of the ordnance of the heavy field batteries used in India Bronze mortars are very useful in the advance trenches in the attack of fortified places, from the facility in moving them from place to place, and in mountain warfare, from their lightness, they are valuable Mortars have generally a fixed elevation, *viz*, 45°, and the length or otherwise of the range is regulated by the charge It is not unlikely that before long rifled mortars will be introduced into the service

Mortar, Eprouvette — An 8-inch mortar, used up to a late date, in ascertaining the strength of gunpowder It has now been superseded by the Navez Leur's ballistic apparatus, which gives both the strength and uniformity of the powder

Mortise—In carpentry, a hole cut in a piece of wood to receive a corresponding projection formed upon another piece

Mortise and Tenon — A description of joint used in woodwork The extremity of one piece of timber is let into the face of another piece, a tongue being formed at the end of the piece to be let in, which is called a *tenon*, and the hole cut in the face of the other is called a *mortise*

Moss-Trooper —A marauder, freebooter, plunderer

Mother-Liquor — The water enclosed in the crystals of various salts before they have been finally boiled and pulverised In the system of refining saltpetre, which has of late years been adopted (*vide* Nitre), the crystals are so minute that no liquor remains within them; this is a great advantage, and lessens the cost of refining

Motion—In this term is involved that part of mechanics known as dynamics, which treats of the action of forces producing motion, and of the laws of motion Motion is of two kinds, either uniform or variable, and is produced by force, and upon the nature of the force or forces depends in what manner the body acted upon will move The simplest case of motion is that of a body moving uniformly in a straight line, or in other words, traversing equal distances in any equal successive proportions of time whatever, when it is called a *uniform* motion

The next in simplicity is that of a body moving in a straight line, but not uniformly, or as it may be described, traversing unequal distances in any equal successive portions of time, when it is called *variable* motion

The motion is said to be *accelerated* when the distances traversed in equal times are successively greater and greater, and when these distances are less and less, it is said to be *retarded*

As regards the laws of motion, they are three in number

The first law of motion states that a particle at rest, and a particle in motion, will continue to move uniformly forward in a straight line, until they be acted upon by some extraneous cause

The second law of motion states that when any force acts upon a body in motion, the change of motion which it produces, is the same in magnitude and direction as the effect of the force upon the body at rest Hence it appears that if the time during which a constant force

acts upon a particle be divided into any number of equal portions, the same change of momentum will be produced by the force during each of these portions of time, and, consequently, the entire change produced by the force during any interval of time, will be proportional to the length of this interval

The third law of motion states, that action and re-action are equal and in opposite directions, and from this law it appears that the changes of momentum produced by different forces in the same time are proportional to the magnitudes of the forces as measured by the weights they would support, and are entirely independent of the masses of the bodies upon which the forces act, and of the nature of the connection of the several parts of those bodies —(Boxer's Treatise on Artillery)

Motion, Parallel—A simple and beautiful arrangement of link-work invented by the celebrated Watt, to convert the reciprocating circular motion of the extremity of the great beam of the steam engine, into a reciprocating rectilinear motion adapted to the piston rod

Moulds for Casting Guns—All British ordnance which are cast in the present day are cast "solid," with the exception of the larger natures of mortars There are two methods of performing this operation, the one being in loam, and the other in dry sand In the former, the operation is again sub-divided into two different systems In England and on the Continent—the first method, which was that formerly practised—a conical wooden spindle is set in the founder's lathe, a rude instrument consisting of two uprights connected together by transoms, with journals on their upper surfaces, on which the ends of the spindle rest Plaited or twisted straw is then rolled round it, the spindle being made to revolve slowly by hand until it has reached to a diameter somewhat less than the shape of the rough gun block which is to be cast The surface of the straw is then secured with loam in several coatings, which are gradually less in thickness up to the last or finishing coat A templet or profile of the block is set horizontally on the lathe supports, and fixed by index marks thereto, so that the edge of the templet shall act as a long turning tool with reference to the surface of the roughly formed loam core The core being then caused to revolve slowly, and the templet being fixed at the hypothenuse of the right angled triangle which generates the truncated cone, the latter "turns" the core to the shape of the required gun block The core is then stoved, and receives a liquid wash to prevent adherence of the loam in the subsequent operation On this core next is formed the mould of the same material, the loam is laid on in coats or layers increasing in thickness as the mould gets larger After it has attained a sufficient thickness, longitudinal bands of iron are attached to it by iron hoops, to strengthen the mould, and to enable it to resist the weight and tendency to expansion caused by the liquid metal being poured into it Finally, over this iron cage more loam is added to protect the caging from injury It should be stated that these operations cannot all be effected at once, layer after layer of the mould must be stoved, and it is found inconvenient to stove, during the night, the previous day's work As soon, then, as the mould is completed, the spindle is knocked out towards its larger end, and the straw

plait gradually and carefully unwound brings away with it, at the last layer, the adhering coats of loam, and leaves a hollow mould of the form of the core, and consequently of the gun block The mould then receives internally the usual wash to prevent adherence of the metal, which would injure the turning tools, and be otherwise inconvenient Under this system, it will be observed, a new core as well as mould has to be made for each piece cast

The other method resembles the above in general details, with the exception of this important difference, that the cores or patterns (for the latter is the proper term) are of cast-iron, they are made once for all, and will last for ever The following is the detail of the operation and the time expended On the 1st day, rather more than one-half of the truncated cone forming the mould, one trunnion being upwards (that is, supposing the pattern to be divided into two equal parts by a plane including the axis of the piece, and perpendicular to the axis of the trunnions), is well oiled to prevent adherence of the loam which is to form the mould A pattern of a runner is placed one end on the edge of the trunnion, and the other half-way up the chase This too is well oiled A layer of well-wrought mould of a thickness of half an inch at the end of the dead-head, 3 inches at the trunnions, and 2 inches at the breech, is plastered over rather more than the upper half of the mould It is then stoved for the two following nights On the morning of the 3rd day, the first layer is covered from the breech to the end of the dead-head with half hoops and longitudinal straps, which embrace and strengthen the 1st layer of the mould A second layer of 1½ inches is then laid over the hoopings and the 1st layer, and stoved during that night On the 4th day, a second set of half hoops and straps is similarly placed over the 2nd layer, and a 3rd layer of about 2 inches everywhere added A line of cavities for hand grips is then made, about 2 inches from each side of this layer along the whole length These are for the purpose of handling the half moulds in the subsequent operations It is stoved for two nights On the 6th day, the mould is turned over, so that the opposite side of the pattern is presented upwards The edges of the different layers are trimmed evenly, so that the half mould thus made shall be truly a half mould The then upper surface of the mould is oiled, and the first layer of the other half mould added as before described This, once more, is stoved two nights On the 8th day, a set of half hoops and straps and a 2nd layer over them added as before This is stoved one night On the 9th day, another set of half hoops, and straps, and 3rd layer are added, and stoved two nights On the 11th day, the mould is opened, the pattern is withdrawn, the pattern of the runners is likewise pulled out, the mould repaired and covered internally with the usual chalk or other wash, to prevent adherence of the metal The two half moulds are then brought together, and closed by two broad strips of hoop iron along the joint, and secured by a number of hoops driven on a foot apart over the whole length. A 4th layer of loam, ½ an inch thick, or sufficient everywhere to cover the hooping and straps, is added over the upper half of the mould, and stoved for one night. On the 12th day, the mould is turned over, and a similar layer of loam added

to the then upper half of the mould, and stoved for one night On the morning of the 13th day, it is ready for the casting pit.

It then takes two days to lower four moulds into the pit, and to build over their heads the brick-work and system of channels, which are supported by a grating formed of strong iron bars On the 16th day, the moulds stand vertically in the pit, the top of the moulds being a little lower than the top hole of the furnace A fire of wood fuel is then lighted in the pit, a flue at the top of which leading to the chimney, carries away the smoke and gases evolved by the combustion and drying of the moulds This fire is kept up day and night for 48 hours (16th to 18th days) The moulds are then allowed to cool down for 48 hours, from the 18th to the 20th day It thus takes three weeks from the day the mould is commenced, to that on which the liquid metal is poured into it

The great labour and loss of time attendant on this system of moulding induced the authorities at Woolwich to endeavour to establish the system termed that of "dry sand," and which is that now adopted

The important difference in this system consists in the fact that the material, dry sand, in which the form of the gun block is made, is retained by cast-iron boxes or jackets These jackets are hexagonal in form Those for the reception of the 9-Pr castings exceed internally the pattern by 2½ inches in diameter at the base, and 10 inches at the head Each jacket consists of four pieces, fitting accurately over each other, two surrounding the gun and lower portion of the dead-head, and the other two the upper portion of the dead-head The lower portions of the jacket are fitted with guide pins and cutters, which ensure perfect truth when brought together after the lining of sand has received the impression of the gun from the pattern on the moulding table Four openings are made along each side of the jacket for the purpose of admitting the sand and for ramming the mould These openings are disposed in a line upon the upper portions of the halves, and are covered with wrought-iron plates somewhat larger than the apertures, and fastened to the jacket with wrought-iron wedges, jamming between the plates and projections cast upon the jacket for the purpose An opening is made in that portion of the jacket which covers the trunnion to permit the sand being well rammed about it, after which it is covered with a plate fastened in the same manner as above The halves which surround the dead-head are fastened together before the mould is made, this part being moulded in a vertical position Each portion of the jacket is perforated with holes three-quarters of an inch in diameter, and about four inches apart, for the purpose of fairly educting the gases formed by the admission of the fluid metal into the moulds

The pattern is in halves, formed of hollow metal castings, truly turned and finished to represent the shape of the gun Each half is fitted to the movable parts of a moulding table, the top plate of which admits of the pattern being raised or lowered through it, the pattern when home, being most accurately fitted to the portion cut out in the table to receive it, the means employed in working the same being racks, pinions, and a worm wheel The portion of the pattern which gives the form of the trunnion, is also

movable within the pattern by means precisely similar to those above

The materials of which the moulds are composed consist of two parts white loam and one of sand, ground together and thoroughly mixed by means of a circular mill, having runners for the purpose When the pattern is brought to its position, its surface is slightly oiled, and covered with a thin coating of burnt sand by means of a sieve, to prevent the adhesion of the mould The jacket is then adjusted over the pattern by means of pins projecting from the face of the moulding table for that purpose The jacket is then filled, and the sand well rammed around the pattern The implement used in this operation consists of a short wooden staff, having a metal head securely fastened to the end of it After the ramming ronnd the body of the pattern has been thoroughly accomplished, the trunnion is raised by the means before mentioned to its seat, for all sand is now rammed around it, and when this is finished, the plates alluded to are secured upon the apertures of the jacket A steel wire is now inserted through the small holes of the jacket, to facilitate the escape of the gases The trunnion is now gently withdrawn as described, after this, the pattern itself, leaving the sand undisturbed and with a correct and sharp-edged impression of the pattern The jacket is now lifted from the table, and any defects made good by the moulder, in the usual manner A curved wire is now inserted at intervals of one inch along each side of the mould in both halves, for aiding, still further, the escape of the gases generated The mould is then coated with a wash of tan ash, pipe clay, and water in the proportion of 8lbs of tan ash, ½lb of pipeclay, and 2 gallons of water well mixed The jacket is then secured as before mentioned, and conveyed to the drying stove, in which it is dried for about 12 hours, at a temperature varying between 450° and 460°

The writer who thus describes this system, states, that out of the number of 180 guns which have been cast in the boxes and manner described, only two have been condemned as unsound

Moulds for Casting Shot or Shell—Are made of metal or sand in the latter case, the sand is similar to that used in casting guns, though a less refractory sand is needed, as the mass of metal is less, and possesses, consequently, a less amount of heat It is mixed with clay-water to give the moulds form and consistency In the manufacture of Palliser projectiles, the heads are cast in metal, or, in other words, chilled, and the bodies, in sand By this method, as explained by Captain Orde Browne, "the head has the full crushing strength, while the body has more tenacity, and probably impresses rather more of its force on the target on impact before it splits away from the head, but the main advantage in casting the bodies in sand is that the metal is believed to be far less subject to the action of the molecular forces, which may either split it in store or crack it so as to cause rupture in the bore of the gun"

Mountain Artillery — Ordnance of small calibre, especially adapted to mountainous countries The ordnance forming the equipment of a Mountain Battery consists in the Home Service of 7 Pr. rifled guns In India, there are a few of these batteries, but the 3-Pr and 4⅔ Howitzer are still in use, and will probably remain so until the weight of the 7-Pr. gun is decided,

which appears at present to be under consideration, with reference to the load an Indian mule is able to carry In the mountainous parts of the Punjab, mules or ponies carry this nature of ordnance In Assam, a country abounding in forest, and subject to much rain, elephants alone are used An elephant carries 1,400 lbs on a level plain In a mountainous country this would be too heavy a load, it has therefore been reduced to 1,000 lbs, which includes the gun or howitzer with the cradle, the gun carriage, and a certain proportion of ammunition The mules in India are smaller, and possibly inferior in strength to the Spanish or European mule, they are from 12 to 14 hands, and the load each mule is capable of bearing is about 260 lbs This, however, would be a heavy load for continuous marching in a hilly country In the Abyssinian compaign, it is stated that by the time the force reached Magdala, 100 lbs was as much as a mule could carry

Mountings — The term is applied to a certain sum given to the soldier, annually, to defray the expense of altering new clothing which does not fit, and is called "half mountings"

Mousing a Hook—Is a mode of passing a piece of spun yarn round the point and back of the hook of a block, in order to prevent its disengaging itself from anything to which it may be hooked

Moving Force — Is measured by the momentum uniformly generated in a given time, and is equal to the product of the accelerating force and the quantity of matter

Mule—The hybrid between the jackass and the mare Mules are used in India chiefly as beasts of burden in the mountainous parts of that country With mountain batteries, they serve as draught cattle, as well as for pack carriage in carrying ammunition The Indian mule is bred in the Himalaya mountains and in the Punjab

Muller — A hand instrument made of wood and covered with leather, it is used in the laboratory for reducing powder to great fineness The term is also applied to the painter's stone for mixing paint

Multiple—Any quantity which contains another an exact number of times without a remainder is a multiple of the latter, and the latter is a submultiple or part of the former

Muncheel—A stretcher for the sick and wounded, similar to the doolie used in Bengal It is a Madras term, and used in that Presidency

Munitions of War—Ammunition of every description, and military stores

Musket or Firelock—The general name given to the arm of an infantry soldier Not many years ago the smooth-bore musket was the universal arm of the Service, but since the introduction of rifled arms it has been superseded, first by the Enfield rifle, subsequently by the Snider rifle or converted Enfield, and lastly by the Martini-Henry rifle The word "firelock" received its name from the action of the flint and steel which composed the lock, producing fire The term is still used in talking of the soldier's arm Muskets were first brought into general use in the year 1690

Musquetoon — A species of musket, but thicker and wider in the bore than the ordinary musket It propelled a ball about five ounces in weight This arm was used towards the close of the 17th century It is now obsolete

Mussuck—An Indian term, a leathern bag for carrying water, slung on a man's back It is universally used in India and amongst other Asiatic nations

Muster—A term taken from the Italian *mostrare*, or French *montrer*, to show, to put forth, to display This definition will at once convey the origin of our word "muster" and explain its object—*viz*, that the troops may show themselves, and be counted over

Muster Roll—A return of all troops and establishments actually present on parade or otherwise accounted for, which is taken of each regiment, detachment, and department, on the last day of every month The presence at muster of all concerned is peremptorily necessary, otherwise an officer or soldier subjects himself to forfeiture of pay unless leave by competent authority has been obtained In the Indian army, leave for sixty days, irrespective of muster, can be obtained by an officer without loss of pay

Mutiny Act—Is an Act, as defined, for the punishment of mutiny and desertion It was first framed in the reign of William III, and is the immediate ancestor of the one in force now With the view of placing a check upon the exercise of the military power of the King the Act was passed for six months only at first This Act, which empowers the Crown to form articles of war, and to constitute military courts-martial, was renewed soon after its expiration, and has been annually re-enacted, with many alterations and amendments, ever since The Act provides for the assembling and constitution of courts-martial, and a variety of other military duties, and the punishment of military crimes and offences

Muzzle, Drooping of—*Vide* Drooping

Muzzle-loader — The name given to all rifled guns which are loaded at the muzzle, to distinguish them from breech-loaders All the newly-made guns are rifled and loaded at the muzzle, and this change from breech to muzzle-loading, in ordnance, has been brought about chiefly from the former system in heavy guns not admitting of large charges being fired, with certain other disadvantages, such as the unwieldiness of the breech loading apparatus, a more dangerous fuze (percussion) being used, and being considered as well a less enduring piece Whereas a muzzle-loading gun as described by Lieutenant-Colonel Owen, R A, "has a simpler, less costly, and stronger construction, the ammunition is less costly, and a simple fuze, without percussion arrangement can be used"

Muzzle of a Gun—Applied to the mouth of a piece of ordnance

Muzzle Stoppers—Used with small-arms, to prevent dust and dirt getting into the barrel

N.

Nadir—That point in the heavens directly under our feet, which is diametrically opposite to the zenith, which is over our head

Naick — An Indian term for corporal in a Native Regiment

Nails—Are used as fastenings in wood and iron work, and for other purposes, they are of different sizes and material Iron nails are either wrought, cast, or cut out of sheet iron wrought nails are also made from plates rolled for the purpose, and then slit by means of slitting rollers into "nail rods" or split rods of various sizes and qualities, according to the variety of

nail required The various "sorts" of forged nails are many, numbering upwards of 300, to which are given specific names, as hurdle, scupped, mop, &c, and are known also under the retail terms of four-penny, six-penny, ten-penny, &c Nails are also distinguished after the forms of their heads and points, as *rose, clasp, diamond*, &c, heads, and *flat, sharp, spear*, &c, points The thickness is expressed by the terms *fine, bastard, strong*, the length of some sorts by direct lineal measure, but it is more usually included in the weight of 1,000 of the nails referred to

Naphtha—A bituminous inflammable liquid It is also obtained by distillation from petroleum

Nasmyth's Hammer — The following description is given in Weale's Dictionary of Terms of Art "Nasmyth's patent direct-action steam hammer is employed instead of the old helves or lift hammers, and is worked by a connected high-pressure steam engine, which raises the hammer to any required height within its vertical range of motion, and in which it is guided by two planed guides On the escape of the steam, when the valve of the cylinder is opened, the hammer falls on the work that lies on the anvil with the full force due to gravity, with scarcely any loss from friction The instant the hammer has given its blow, the steam is again let in under the piston, and the same action is repeated with ease and rapidity"

Nasmyth's steam pile-driving Engine —"There are two grand or important features of novelty in this pile-driving engine, compared with all former contrivances for the like purpose In the first place, by the employment of the steam-hammer action, the steam is made to act direct in raising up and letting fall the hammer, or monkey, without the intervention of any rotatory motion, while, in the second place, another grand feature consists in the employment of the pile about to be driven, or raised up and planted in its situation by the machine, by means of a windlass worked by a small detached steam-engine Some conception of the rapidity with which piles are driven by this machine may be formed, when it is stated that a pile measuring 60 feet in length, and 14 inches square, can be driven 45 feet into stiff soil, down to the rock below, in four minutes, and such is the good effect resulting from the blows being given by a great mass of 30 cwt striking quickly, but with small velocity of actual impact, that the head of the pile requires no hoop, and presents, after being driven, a neater appearance than it had when it was first placed under the hammer"

Nave—The central part of a wheel, generally composed of a cylindrical block of wood in which the axle-arm works In Bengal, naves are usually made of sissoo, in Madras and Bombay, of babool, but in these Presidencies, the nave at one time used was of metal, composed of two metal discs or circular plates of equal dimensions, with the nave box passing through their centres In the Madras wheel, the nave box is cast in one piece with one of the plates, but the principle of construction is the same, whether it is so united, or cast separately Between the two plates are placed the 12 spokes, the latter so formed, that the parts which enter the nave are in close contact with each other, and with their ends forming an arch completely round, but not quite touching, the nave box The whole

construction is then firmly bolted together, with 12 triangular bolts passing through holes in the discs, and fitting into the triangular spaces formed between each spoke by their radiation from each other These bolts have circular heads, and when driven into their places, their ends are secured outside by nuts The naves are in two or three parts The great advantage in the latter is that the top and bottom, as two of its parts are termed, are almost rendered perpetual, whereas in the nave in two parts, if the box wears and therefore becomes unserviceable, the box with bottom, altogether nearly ¾ of the nave, is rendered useless, and must be renewed, but with the nave in three parts, the box alone is renewed if it wears away

In the late Madras Artillery, the gun-metal nave has been in use for the last 60 years, and no failure of its strength or durability has ever been reported For many reasons it appears a great improvement on the royal pattern block nave, and Artillerists will be glad to know that it has been introduced into the service for the wheels of all carriages liable to come under fire The compiler can speak as to its durability from an experience of some years in the charge of Madras gun-carriages whilst on service in Burmah In that country, for two or three years after it was annexed to the British possessions in 1852, gun-carriages, Bengal and Madras, had to stand out uncovered and exposed to sun and rain During that period not a Madras wheel was the worse for exposure, whereas the majority of the Bengal wheels had large deep splits in the wooden naves, which necessitated their being replaced, and the wheels set up afresh

Very serviceable naves can be made from the preserved or non-decayed parts of condemned naves put together in three pieces, and termed "compound" or "joined naves"

Navez' Electro-Ballistic Apparatus— *Vide* Electro-Ballistic Apparatus

Near—Applied to the left hand or riding horse of a team, to the left feet, fore or hind, of an animal, to the side or stirrup on which the horse is mounted

Necessaries — In a military sense, are such articles of clothing, &c, as are provided by the State to the soldier on his first entering the army, and which he has to keep up at his own expense The articles which compose the necessaries of an artillery soldier will be found under the head of "Kit" in the Appendix

Neck—In artillery, the narrowest part of a piece of ordnance, comprised, in smooth-bore guns, between the muzzle astragal and fillets and the swell of the muzzle It is also that portion of metal behind the breech ogee, termed the neck of the cascable, and which is contained between the neck fillet and the button astragal

Needles—In the ordnance department, needles are used for the following purposes Needles, sewing —in making cartridge bags, making and repairing flags, &c Needles, sail —in making and repairing powder cloths, paulins, and other articles made of vitry, canvas, or double gunny Needles, packing — in sewing single gunny, and in covering boxes and other packages

Needle-Gun — This weapon, which is the small arm of the Prussian service, is thus described in the *Birmingham Gazette* —The "Zundnadelgewehr," or needle-gun of the

Prussian service, to which the victories of the Prussian arms in 1866 have been attributed, appears to have been originally patented in England as a muzzle-loader in 1831, by a Mr Moser, of Kennington The invention came before its time, its cold reception in England drove the patentee to seek foreign patronage for his novelty, and Prussia was lucky enough to appreciate and to adopt the new weapon Dreysa, a gunmaker of Sommala, applied the breech-loading principles to Moser's patent , and thus amended, the arm, ten years later, was, in 1848, introduced into the Prussian service The principle, briefly stated, is the driving of a pointed piston or "needle," by the action of a spiral spring (such as is used in the manufacture of children's toy guns) into a small case of fulminate contained in, and situated between, the powder and the bullet of a single cartridge In the action of opening the breech, the spiral spring is set by the trigger, and thus the trigger, when pulled, releases into operation the spiral spring, which, in its turn, forces the needle into the cartridge and fires the piece Upon this oldest form of the Prussian needle-gun improvements have been made, the chief effects of which have been a reduction of the mechanism of the needle of 1848, and a general lightening of the entire piece None of these alterations, however, have touched those two apparent evils in the old form of this arm which militated against its adoption by England in 1850 These are, the position of the fulminate in the interior of the cartridge, and looseness of mechanism, involving possibility of the escape of gas round the needle and at the base of the plunger To these two particular points France mainly devoted herself in seeking a superior needle rifle to that of Prussia "

Neutrality—As explained in Brande and Cox's Dictionary, is "the condition of a State which does not take part in a war between other States A neutral nation has the right of furnishing to either of the contending parties all supplies which do not fall within the description of *contraband of war*, and to conclude treaties with either unconnected with the subject of the war It appears to have been the old principle, with regard to the maritime trade of a neutral nation, that the property of an owner belonging to the hostile country might be seized by a belligerent on board a vessel, or vessels, belonging to a neutral power , but the general rule now asserted is that the flag covers the cargo , by which means right of search, except for specific purposes, is rendered unnecessary By the declaration of March 28, 1854, made on the occasion of the Russian war, England *waived* the right of seizing enemy's property on board a neutral vessel, unless contraband, but did not abandon it "

Night Firing — The direction being known, and the gun or mortar having been properly laid, while it is light, battens should be nailed to the platforms, touching the felloes of the wheels or trucks or side of the mortar bed The elevating screw or quoins must also be fixed A much superior method of laying guns or mortars will be found under the head of Collimator

Nipple—The passage of communication in percussion arms between the cap and the charge , the percussion cap is placed on the nipple when the firelock is primed and by the action of the lock the piece is discharged In breech-loading arms, there is a different arrangement for igniting the

charge, which renders the nipple unnecessary, these are fired by means of a needle or some similar method

Nitrate of Silver—The most important of the salts of silver It is prepared by several methods

1st—By dissolving pure silver in dilute nitric acid with the aid of heat, and evaporating to crystallization

2nd—From standard silver dissolved in dilute nitric acid, the solution evaporated to dryness in a porcelain dish, and the residue heated nearly to redness The nitrate of silver fuses without change, but the nitrate of copper is decomposed, leaving the black oxide of copper, a small portion of the mass is removed from time to time, dissolved in water, the solution filtered, and tested with excess of ammonia When this re-agent ceases to produce a blue colour, the process is completed, and if the residue be treated with water, the solution will yield, on evaporation, crystals of pure nitrate of silver It is used in the laboratory for the precipitation of acids

Nitre — Or saltpetre, chemically called Nitrate of Potassa (KO NO^5) This salt occurs in nature as an incrustation upon the surface of the earth in hot climates, such as India, Arabia, and South America In Bengal, it is found in great abundance, especially in the districts of Tirhoot, Behar, and Agra Wherever saltpetre exists, the ground is found impregnated with saline matter and perfectly barren During the periodical rains, these districts are overflowed, the various salts are dissolved and brought into contact, when new combinations follow, and fresh salts result, as the water evaporates or percolates the soil These are found and collected, and after repeated washings, evaporations, &c, the nitre passes into the market, where it undergoes crystallization, and is in this state exported to Europe The crude mass is called in Hindustani "dhoah," and when transformed into crystals and well washed, "calmee," and valued at 94 per cent of pure nitre, which, however, is very much over-estimated Saltpetre, before it is made use of as an ingredient for gunpowder, has to be thoroughly refined, so as to free it from all its impurities, which consist of extraneous salts, such as muriates, sulphates, &c, and this process is performed by boiling the crude saltpetre in large copper pans, for six or eight hours, removing, on its becoming heated, all the scum that floats on the surface It is then pumped off and received into filtering bags, and the liquid, after passing through these bags, is conveyed by a copper pipe or channel into the refining room, where large cisterns, lined with copper, are ready to receive it Immediately on the liquid falling into the cisterns, it is agitated with wooden rakes, until fine crystals of saltpetre form, which are raked up and placed on a sloping frame, where they remain till sufficiently drained, after this the saltpetre is thrown into a washing cistern, which has a false bottom, and thoroughly saturated with filtered water, and subsequently with distilled water,—in the former case for a couple of hours, in the latter for four-and-twenty,—when it is drawn off, and the saltpetre thrown into a drying bin, which has also a false bottom It is afterwards dried either by solar or artificial means, and packed away in barrels The proportion of grough saltpetre to water is about 1½ lbs of the former to 1 lb of the latter A charge of saltpetre is about 40 cwt, mixed with 270 gallons of water For the method pursued in testing nitre, *vide* Saltpetre

Nitrogen—This is the gas which exists in the air, and dilutes the oxygen so as to moderate its activity and fit it for the proper maintenance of life, combustion, and numerous other offices it has to fulfil Nitrogen, in its pure state, is quite free from smell, it instantly extinguishes flame, and cannot support life Atmospheric air is a mixture of very nearly four measures of nitrogen with one measure of oxygen, it contains, besides, small quantities of other gaseous substances, as vapour of water, carbonic acid, and ammonia

Nodes—In astronomy, are the opposite points of a planet, where its orbit appears to cut the orbit of the earth or ecliptic

Nolan's Range Finder—*Vide* Telemeter

Nomenclature—As applied to military stores, signifies the name given to each article used in the service

Nominal Power—By this term is understood a steam engine having a cylinder of given diameter, a given length of stroke, with a uniform pressure upon the piston of 7 lbs per inch By the term "actual" power is meant the number of times the engine is capable of lifting 33,000 lbs 1 foot high per minute

Non-Commissioned Officer—As the name implies, is an officer without a commission, but who by his position in a regiment, and by virtue of the power attached to that position, exercises control over those beneath him, such as a serjeant over the private soldiers of his regiment Sergeant-majors, quarter-master sergeants, and sergeants are the N C O of a regiment A non-commissioned officer can be reduced to the ranks by order of his colonel or commanding officer without the intervention of a court martial, but so long as he holds his rank he can receive no minor punishment

Non-condensing Engine—A high pressure engine, the steam not being condensed after leaving the cylinder, but passing out into the atmosphere after having acted upon the piston

Non-conductors—Substances through which the electric fluid passes with considerable difficulty or not at all, such as glass, resin, sulphur, silk, hair, wool, the air, &c

Non-effective—In the army, are the officers or men employed on other duties than regimental, such as in Staff appointments and the like The term is used as the primitive or negative of effective

Notch—A nick, a hollow in anything In gunnery, the groove on the base ring, or tangent scale, and swell of the muzzle, or on any other sight by which a gun is laid

Nozzles — Those parts of a steam engine in which are placed the valves that open and close the communication between the cylinder and the boiler and condenser in low pressure or condensing engines, and between the cylinder and boiler and atmosphere in high pressure or non-condensing engines

Nullah—An Indian term, signifying a small stream, or the arm of a river, also the place which was once the bed of a river

Numdah—A species of felt, used, among other purposes, as a pad under saddles

Nut—A square or hexagonal metal or wooden block, having a spiral hole through its centre into which a screw fits, and by the interplacement of the threads of which, with those in the nut, "the cohesive strength of the hold" consists

O.

Oakum—The untwisted strands of old rope It is used in packing shot and shell, wiping the vents of guns after firing, cleaning elevating screws and different implements, and also in making washing sponges

Oath—According to Brande and Cox's Dictionary, an oath is defined by Paley as, 'the calling on God to witness, *i e*, to take notice of what we say and invoking His vengeance or renouncing His favour, if what we say be false, or if what we promise be not performed' By the jurisprudence of nearly all known nations, it has been admitted, in one form or another, as the solemn test of truth in judicial proceedings In military courts-martial, evidence is given by most Christians on oath sworn on the Bible, except by such sects as profess conscientious objections to oaths

Obedience — The first duty of an officer or soldier is obedience to orders This is the life-spring of the army without it no body of men can be kept together It is a principle therefore which cannot be too strongly inculcated amongst all ranks

Objective—A technical military term signifying, as the word implies, the aim or object of the military combinations and movements on the theatre of war

Oblate—Flattened or shortened In geometry, a term applied to a spheroid, produced by the revolution of a semi-ellipse about its shorter diameter, of this figure is the earth

Oblique Fire—Taking the enemy slantwise Thus when two batteries bring their fire directly upon one point of the enemy's line, they make what is called a cross or concentrated fire, which is very destructive upon columns, though not so effective as enfilade fire

Observatory—A building erected for the purpose of taking astronomical observations, and which is furnished with the most approved instruments In Europe one of the first observatories was built by Tycho Brahe, a nobleman of Denmark, on the island of Huen, in 1576 The observatory of Paris was built in 1667, that of Greenwich in 1675 Public observatories are now maintained in almost every civilised country, and there are several private ones in England By the daily observations made, and the means taken of publishing these observations, a great advance has been made in astronomical science (Brande and Cox) In different parts of India, and especially near Delhi, the remains of large native observatories are to be seen, showing the great interest, and as we know, the intense study given by the natives of India to the sidereal world

Obstacles — The impediments used to render the approaches to field works more difficult to the enemy Of such are palisades, stockades, barriers, abatis, trous-de-loup, chevaux-de-frise, harrows, crow's feet, fougasses, and inundations

Obtuse Angle—That which is greater than a right angle

Off—A term used in speaking of horses harnessed to a carriage, in contradistinction to *near*

Off-Reckonings — An allowance formerly made to the Commanding Officers of Regiments and Captains of Companies, out of the annual clothing money set aside for their men The allowance was subsequently only given to the Colonels of Regiments, and was a fluctuating sum, depending on the amount of the surplus left after the clothing was made up About eighteen years ago an average of thirty years' "off-reckonings" was struck, and

a fixed sum from that period allowed yearly to Colonels, termed "Colonel's Allowance" The term "off-reckonings" is now therefore obsolete

Off-sets—In surveying, a curved boundary, the surveyor measures a straight line as near to it as convenient, and makes this line a side of one of the triangles from different points of it to the curve These are called off-sets They must be perpendicular to the straight line, and are usually measured with straight rods, placed against the measuring chain without disturbing it In this way, means are furnished for plotting as many points of the curve as there are off-sets, and through these points the map may be drawn

Offence, guns of—Are generally heavy guns, because they combine the longest range with the greatest accuracy, and the most destructive effect

Officer — According to Johnson, a man employed by the public In a military sense, the name is applied to those in a regiment who exercise control or command It is also applied to a person acting in a civil or military situation under Government

Ogee—A moulding in architecture, partly concave and partly convex Mouldings termed ogees are cast on smooth-bore ordnance and mortars, and are known in the former as the breech and base ring ogees, in the latter as the reinforce and muzzle ogees

Oils — Those used for Artillery purposes are chiefly vegetable oils, such as the cocoanut, mustard, and linseed oils, the two latter being extracted from the seeds of these plants by expression, and the former in the same manner from the cocoanut palm. The nut having been stripped of the husk or coir, the shell is broken, and the fatty lining enclosing the milk is taken out This is called *cobri*, *copra*, or *copperah*, in different localities Three maunds of *copperah* are thrown into the mill with about three gallons of water, and from this is produced three maunds, or seven and three-quarter gallons of oil The use these oils are put to is as follows —

Cocoanut oil, for clearing elevating screws and different other articles It should never be used for the barrels of small arms, as it contains an acid destructive to the interior of the barrel Mustard oil, in preparing hides, and used by laboratory men, after working carcass composition, &c, for cleaning their hands Linseed oil, in making paint, and also to mix in paint which becomes thick from long keeping There is also another oil,—*viz*, that derived from the gurjun tree (wood oil), which is made use of in arsenals, and found to answer better for painting on tin than any other, and which should be used for case shot, &c, it is very volatile, and dries rapidly even in wet weather, at which time common oils dry very slowly For the preservation of small arms from rust, petroleum oil, refined, and known as "Price's Rangoon Oil," is now used in the Service Petroleum is a rock oil, and procured from the bowels of the earth from wells sunk to the depth required Its colour in its crude state is a dark green, but when refined and distilled, it is perfectly transparent Burmah, Canada, and North America produce large quantities of petroleum

Olympic Games—Were instituted, so it is stated in James' Dictionary, by Hercules, A M 2856, in honor of Jupiter Olympus, at Olympia, a city of Elis, in the Peloponnesus They were celebrated every four years The design of them was to accustom the young

military men to all athletic and military exercises

Opening of the Trenches—Synonymous with breaking ground, or the commencement of the works of attack against a fortress

Operations, Base of—With reference to an army, as explained by Col Macdougall, is "the point, line, or district from which it starts, and from which all its re-inforcements and supplies proceed, when it is committed in a campaign It may be a single town, it may be a frontier line of any length, or a line of sea-coast, if the army possesses the command of the sea, or it may be a district of country having breadth as well as length Whatever be its nature, it must be such that the army retreating upon it, in case of disaster, shall, on reaching it, find succour and safety"

Orbit—In astronomy, is the path described by a planet in its revolution round the sun

Ord's Fuze — Used in mining It is waterproof, and therefore useful for sub-marine purposes

Order of the Star of India—An Order instituted by Her Majesty Queen Victoria, in 1861, for the purpose of rewarding persons for conspicuous merit, who have rendered important service to the Crown in India There are three classes in the order,—twenty-five Knights Grand Commanders, fifty Knights Commanders, and one hundred Companions The insignia are the collar, composed of the heraldic rose of England, two palm branches, in saltire, tied with a riband, and the lotus flower, alternately connected together by a double gold chain In the centre is the imperial crown, from which is depended the badge, consisting of a mullet set with brilliants, over an oval medallion containing an onyx cameo bust of the Queen, surrounded by the motto of the order, "Heaven's Light our Guide"

Orderly Room—The Court of the Commanding Officer, where charges brought against the men of his regiment are investigated, and sentence passed It is also the office of the Commanding Officer from which all orders emanate

Ordnance — By this term is understood in the British Service any description of warlike stores, but its special signification as used by the Artillery comprehends every projectile fired from a gun, as well as the gun itself, forming a part of the equipment of that branch of the military service, and also a portion of the material For the list of ordnance, smooth-bored and rifled, at present in the service, *vide* list attached at the end of the book

Orillon—In fortification, the circular part of the flank towards the shoulder of a bastion, which serves to cover the rest of the flank

Orpiment — A sulphuret of arsenic There are many varieties of orpiment, one in fine golden coloured scales, another in dense yellow stony lumps, a third in earthy looking masses, called King's Yellow, a familiar paint, but the orpiment used in the laboratory for blue lights, signal lights, and parachute light balls, is the red proto-sulphuret or realgar

Oscillating Engine — This engine derives its name from its cylinders "oscillating" upon hollow axes or trunnions, through which the steam is admitted to, and withdrawn from, the cylinders, the piston rod by this means accommodates itself to the motion of the crank, without the parallel motion being required

Oscillation—The motion which a pendulum undergoes when moved by

any force, and which is indicated by the centre of gravity, describing alternately a circular arc on the one side or the other of its position of rest If there were neither friction nor atmospheric resistance, this motion of vibration or oscillation, on either side of the position of equilibrium, would continue for ever, but in consequence of these resistances, the distance to which the pendulum swings decreases more and more with every swing, until it comes to rest

The centre of oscillation is that point in a body vibrating about a horizontal axis, in which, if the whole mass of the body be supposed collected, the period of oscillation will be the same as before

Out-lying Picquet—*Vide* Picquet

Out-post — A body of troops posted beyond the bound or limits of the encampment Officers commanding out-posts should make themselves thoroughly acquainted with the locality in which they are placed, by carefully examining the post, the heights within musket shot, the roads and paths leading to or near the post, ascertaining their breadth, and practicability for cavalry or artillery, in order to insure a constant and ready communication with the adjoining posts and vedettes The hollows which may cover the enemy's approach should be examined, and all points considered with reference to the possibility of an attack

Out-post Duty—The object of this Service is thus explained by Col Macdougall in his Theory of War ' The safety of an army in an enemy's country materially depends on the manner in which the out-post duty is performed The out-posts, picquets, and advanced sentries are the watch-dogs of the army, whose peculiar business is to detect and give timely warning of the approach of an enemy, as well as every circumstance which may appear to threaten its safety An officer in command of an out-post should invariably act as if the safety of the whole army depended on his individual vigilance, and he should impress the same feeling of responsibility on the mind of every one of his sentries "

Outrance — A French term, to the utmost, to the last extremity Thus the French say, *battre a outrance,* to fight to the last extremity

Out-works—In fortification, are the works constructed beyond the enceinte or body of the place and the glacis, such as ravelins, tenaille, horn and crown works, counter-guards, lunettes, covered ways, &c

Oxidation—The conversion of metal surfaces into rust, by their combination with a certain portion of oxygen

Oxide of Iron—Results from the combination of iron with oxygen, in sufficiently large quantities to cause it to lose its metallic state

Oxygen — One of the elements widely diffused throughout nature, but which is never found in a pure isolated form In the atmosphere, it is mechanically mixed with nitrogen, in water, it is chemically combined with hydrogen Oxygen was discovered by Priestley in August 1774, and one year later by Scheele, who was then unaware of Priestley's discovery Eighty-nine per cent (by weight) of water consists of oxygen, atmospheric air contains twenty-three per cent of the same element, which also exists in combination with most of the other elements in various proportions

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P.

Pace—The rate at which a man or animal moves, either at the walk, trot, or gallop The usual length of a man's pace is about 30 inches, and the soldier is trained to take this length A horse walks at the rate of 328 feet in a minute, or nearly 3¾ miles an hour, trots 656 feet in a minute, or narly 7½ miles an hour, and gallops 1312 feet in a minute, or 15 miles an hour

Pack Saddle—That used in the Abyssinian campaign for the transport of mountain artillery with its ammunition, stores, &c, was the Otago pattern It is carried on mules or ponies The weight of this saddle, with harness complete, is 45 lbs 8 ozs, but when issued for mountain artillery, the baggage straps, weighing 6½lbs, are not required, reducing the weight to 39lbs

Pack Thread—A coarse thread or string used for sewing up and securing packages

Package—This term is applied to the wrapper or packing cloth round stores in transit, or whatever constitutes the covering of stores for their preservation Old package in arsenals is collected and sold by auction on account of Government

Package of Ammunition—In the Artillery Service, this is carried out in boxes of a sanctioned pattern, and the ammunition, shot, or shell is secured in compartments or in some other way most convenient or suitable The boxes are carried on ammunition wagons, which escort the guns

Small arm ammunition is packed in boxes, and carried on a campaign in special wagons made for the purpose

Packing Boxes—Are used for keeping " fixed shot or shell" in store, or in transit from place to place, or on the march with siege trains

Paddling — In the manufacture of gunpowder, paddling is resorted to when the powder, in the incorporating process, clings to the surface of the rollers It is performed by means of a copper spud, and is a very dangerous operation, but must be had recourse to at times, the seldomer the better

Padlock, Spring—The pattern padlock used as the fastening of artillery ammunition boxes

Pads—In the Artillery and Cavalry service, are used to protect saddle and draught horses from galls The pad recommended is in the form of a folded blanket, or pad made of sheep and kid's skin, stuffed with hair, 6 inches by 4 inches When placed above and below the gall, considerable relief will be afforded

Elastic pads constructed of a certain number of tubes of vulcanized caoutchouc united together and invented by General Angelini of the Italian army, are stated to have been very successful in the Italian Cavalry in preventing galls These tubes have the advantage of being elastic, cool, light, protect the horses back from shocks and shakings caused by trotting and leaping, &c, and distribute the weight equally over all the surface of the pads

To elucidate more clearly and fully the advantage of this invention, it will suffice to show that, placing the hand under a pad, and upon the latter the weight of one or two men, no pain is experienced in the hand

Paint—A kind of paste made by grinding white lead and linseed oil together, other substances are used, such as coloring matters or " stainers," drying materials or " dryers," &c, but white lead is the basis of all ordinary paints, and forms at least $\frac{8}{10}$ths of their composition The several kinds of paint in use in arsenals and

magazines are anticorrosion, carriage, black, red, green, and white, lacquer for bores of iron guns, and vermillion The mode of preparing them is by grinding the several ingredients in oil on a stone with a muller, or when required in large quantities, as is frequently the case with anticorrosion and occasionally with carriage paint, in a paint mill The simplest and best construction of paint mill for arsenal purposes, is a large iron mortar, having for a grinder a bolt of iron about twice the depth of the mortar in length, with a $5\frac{1}{2}$-inch common shell fixed to either end, and two or three round shot of sizes The grinder resting obliquely in the mortar is easily moved round by one man, and by its movement the loose round shot are kept in constant motion The ingredients should be ground in only a portion of the oil allowed, the remainder being added as the paint is required for use

Paint-mixed, Anticorrosion—Composed of 50 parts of dry anticorrosion paint, lamp black, and red lead, each $3\frac{1}{2}$ parts, and Europe linseed oil 50 parts It is used as a lacquer for the exterior of iron guns, for cast-iron garrison carriages, war rockets, and very generally on iron work which is exposed In all cases the iron work should be first well cleaned For painting shot and shell in piles, country linseed oil is substituted for Europe linseed oil in a like proportion, but it should be first boiled, adding to every 20 lbs of it $2\frac{1}{2}$ ounces of litharge as a dryer This paint has been superseded by Pulford's Magnetic Paint

Paint-mixed, Black—Made of 1 part of lamp black, and 3 parts of Europe linseed oil It is used for marking stores, and generally to form a black ground on canvas or wood

Paint-mixed, Carriage (Bengal or dark slate color)—Consists of lamp black 1 part, white lead 20 parts, and linseed oil 21 parts It is chiefly used in painting field and siege carriages and battery stores, also spherical shell and their packing boxes, to distinguish them from other projectiles, and on wood-work generally

Paint-mixed, Carriage—(Dark blue color) Made of Prussian blue $1\frac{3}{4}$ parts, white lead 15 parts, Europe linseed oil $7\frac{3}{4}$ parts It is used in the Home service for the same purposes as the Bengal carriage paint This paint may be made a lighter or deeper colour by increasing or decreasing the proportions of Prussian blue and white lead respectively

Paint-mixed, Green—Made of verdigris and linseed oil $2\frac{1}{2}$ parts of each, and white lead $3\frac{1}{2}$ parts Its principal use in magazines is for painting lanterns

Paint-mixed, Red Lead—Made of red lead 2 parts, and Europe linseed oil $1\frac{1}{4}$ parts It is used for painting water engines

Paint-mixed, Red Ochre—Made of red ochre 1 part, and wood oil $1\frac{1}{2}$ parts Used for painting fixed shot and common shell, also for case shot and their packing boxes If required for marking stores, linseed oil should be used instead of wood oil

Paint-mixed, Vermillion—2 parts of vermillion to $\frac{3}{4}$ parts of Europe linseed oil Used for drum hoops Spirits of Turpentine, 1 lb, is allowed to every 20 lbs of prepared paint, to be mixed at the time it is used

Paint-mixed, White—Composed of 1 part of white lead to $\frac{3}{4}$ parts of Europe linseed oil It is used for marking purposes, the interior of gun and water buckets, and generally for a white ground

Paint or Lacquer for Bores of Iron Guns—Contains 1 part of red lead, 10 of black lead, ½ part of lamp black, and 20 parts of Europe linseed oil The bore should be thoroughly cleaned before applying this lacquer This paint has been superseded by Pulford's Magnetic Paint

Painting—All gun carriages are painted periodically in India , and in each of the Presidencies there are certain orders laid down, as to the time of the year when this duty should be carried out Generally, after the rainy season is the best and most convenient period Carriages standing out exposed to the weather throughout the year should be painted twice with two coats each time, and those which have been kept under cover in gun-sheds, &c , should be painted but once in the year with two coats of paint

Paixhan's Gun—A shell gun or howitzer introduced into the French and Russian Navy by a French General of that name Loaded shells, with time fuzes, are the projectiles fired from this piece The destruction of the Turkish fleet at Sinope was caused by these guns

Palisades—Form one of the auxiliary means of defence in permanent and field fortification in the former, they are usually planted in the covert way, and in the latter, in a ditch of the work Where there is a covert way, palisading becomes indispensable, and the palisade is usually fixed on the banquette, about one foot from the glacis, and standing about one foot above the crest Palisades for permanent works are constructed of timber sawn into lengths of 8 or 10 feet long, and 8 inches and 4½ inches square, depending on the size of the timber Palisading for field works is seldom of timber sawn into scantling, but is constructed of unhewn timber of trees suited to the purpose, planted firmly in the ground, and connected above with a riband, into which the palisades are spiked The position of the palisading for the security of field fortification should be under musketry fire from the parapet, or flanking work, to command the ditch

Palliser's Guns — These guns bear the name of an officer of cavalry, who has devoted much of his time and resources to the subject of Artillery, and is the proposer of a method of strengthening cast-iron guns, with internal tubes of wrought-iron, and rifled

The object of the conversion is to utilize old cast-iron guns for general service The result of the experiments is that guns are capable of a greater amount of endurance than before they were re-lined, and that as shell-guns, they are well adapted for use against wooden ships, or the land-fronts of forts The guns which have been chiefly converted and experimented upon are the 8-inch and 32-Pr which have been converted into 64-Pr rifled muzzle-loading guns, and the 68-Pr into 7-inch rifled guns, and other calibres

This officer's name is well known to Artillerists as the inventor of the chilled shot

Pane—The face of an anvil or hammer

Panic—A sudden and groundless alarm which is known to seize upon men's fancies without any visible cause The word traces its origin from the mythical story of the God Pan, who is stated, during the Indian expedition of Bacchus, to have been surrounded by enemies, and that the shouting of his men, favored by the echoes of a rocky valley, so frightened them that they instantly took to flight, and hence, as

James points out, it came to pass, that all sudden fears impressed upon man's spirits without any just reason, were, by the Greeks and Romans, called *panic terrors*

Pantograph — An instrument for copying drawings on a larger or *smaller scale than the original*

Pantometer — An instrument for measuring all sorts of angles, elevations, and distances

Paper—The following table contains the names and dimensions of many of the writing and drawing papers in use, with their size —

	Inches		Inches
Antiquarian	52½	by	30½
Double Elephant	39½	,,	26½
Atlas	33	,,	26
Columbian	34½	,,	23
Elephant	28	,,	23
Imperial	29½	,,	21½
Super-royal	27¼	,,	19¼
Royal	23½	,,	19
Medium	22¼	,,	17¼
Demy	19½	,,	15¼
Foolscap	16½	,,	13¼

Drawing papers are not made smaller than demy Writing papers are not made larger than double elephant, and seldom larger than imperial

Paper, Europe Port-fire—Used for port-fire and signal rocket cases, and for rough reports and returns on service from the Artillery Park and Batteries

Papier-Mache — A substance made from the pulp of paper which has been ground up with other materials It is susceptible of being moulded into any shape or form In the Artillery service it is used as wads for fuze holes, &c

Parabola—The curve described by a body which is under the influence of an impulsive force and gravity only

It is also thus described "One of the conic sections formed by the intersection of a plane and a cone when the plane passes parallel to the side of the cone"

Parabolic Theory—In gunnery, has reference to the laws which govern the flight of a projectile in vacuo The deductions from this theory were in the very early days of Artillery science considered to be applicable to a projectile fired in a resisting medium, but it is now well known, as explained in Sir H Douglas's Naval Gunnery, that it is valueless in practice, except when the initial velocities of projectiles are less than 200 or 300 feet in a second, when the resistance of the air is very small In such a case, indeed, the propositions of gunnery may be solved by the parabolic theory with tolerable accuracy, but with greater velocities the conclusions are grossly erroneous It will neither serve to determine the range when the elevation and initial velocity are given, nor if the time of flight were observed and the range measured, could the initial velocity be computed from those data

Parachute Light Ball—A suspended light proposed by Colonel Boxer, R A, and which is used for the same purpose, as *ground light balls, viz* to light up the enemy's works and working parties, but to which it is preferred, from the facility with which light balls can be extinguished The *parachute light* consists, as described in Lieutenant-Colonel Owen's Modern Artillery, of a thin iron shell formed by two hemispheres, the lower one filled with composition, and the upper one with the calico parachute packed tightly in and attached to the case by a cord, this last hemisphere is attached to the one outside it by two chains The parachute is connected to the

lower hemisphere, which holds the composition, by ropes attached to three chains hooking into the hemisphere The outer upper hemisphere has a socket for a fuze, and two leaders of quick-match pass round from the latter to the vent in the bottom of the hemisphere containing the light composition, which is nearly the same as that used for signal lights These balls are fired from a mortar with low charges The fuze is bored, so that when the light has reached the highest point of the trajectory, it ignites the quick-match and priming of the light, sufficient force being thus obtained to separate the halves of the outer shell and release the parachute, which, expanding, and with the hemisphere holding the composition burning brightly from the vent hanging from it, is supported by the air, and descends very slowly

Parade—In a military sense signifies any place where troops assemble for muster, inspection, or drill, or indeed for any duty

Parallax—A change of apparent position of any celestial object, or the difference between the true and apparent place of the heavenly bodies

Parallel Lines — Straight lines which are in the same plane, and which being produced ever so far both ways, do not meet, are called *parallel lines*

Parallel Motion—*Vide* Motion, Parallel

Parallels—Deep trenches formed to connect the several approaches carried on before a besieged place

Parallels of Latitude—Small circles supposed to be drawn on the surface of the earth, north and south of the equator, and parallel to it, dividing the globe into two unequal parts Parallels of declination are such circles produced in the heavens, north and south of the equinoctial, and parallel to it

Parapet—Derives its name from the Italian word *parapetto*, or breastwork In a permanent work, the parapet is the covering shot-proof mass on the exterior side of the rampart In field works, it is a mass of earth thrown up as a protection against an enemy's progress, the ditch from which the earth is excavated forming an additional impediment The parapet should always be of sufficient height to screen the defenders from the view of the enemy, and therefore, on level ground, the height must be nearly 8 feet But if a work be intended merely to cover a guard, or to hold out against a sudden assault, a parapet of 6 feet high will, in many cases, be sufficient The thickness should vary in proportion to the calibre of the projectile which the parapet is intended to resist

Parbuckle—In artillery exercise, to roll a gun, so as to cause it to move in either direction from the spot on which it rests For this purpose, the gun must be placed on skids, and if it is to be moved up or down a slope, two 4½-inch ropes must be made fast to some suitable object on the upper part of the slope, and the ends carried under the chase and breech of the gun respectively, round it and up the slope If the running ends of these ropes are hauled upon, the gun ascends, if eased off, it descends If the ground is horizontal, handspikes only are necessary to move the gun If the slope is not great, one rope will suffice to parbuckle a gun up with In this case, it must be made fast to one of the trunnions, and passed as many times round the gun in rear of, and close to them, as may be convenient, the running end coming out

as before over the gun and up the slope. In hauling the gun up, the rope uncoils itself The breech end of the gun, on account of its greater thickness, will always advance quicker than the muzzle

Parchment—The dressed skin of an animal, which is used for legal and other documents Soldiers' final discharge certificates are made out on parchment

Pare — In carpentry, to cut or trim the surface of a plank with an adze In farriery, the expression means to cut or pare down the hoof of a horse in order to fit the shoe

Park, Artillery — A piece of ground selected for the encampment or depositing of the artillery and carriages of an army, ammunition, &c, whether on the march or during a siege The park should be as near the ground on which the batteries of artillery stand, as is consistent with safety

Park, Siege—The name given to the whole train of artillery matériel belonging to an army in the field, or to what is kept in readiness in arsenals for service A siege park contains the guns, spare carriages, reserve ammunition, gun and small-arm tools and materials for repairs, and for making up ammunition for the service of an army in the field The park is placed under the charge of an officer, generally of the Ordnance Department, specially appointed for this duty, who is assisted by subordinates of the same department

Parkinsonia—A shrub found commonly in Bengal It has been stated to yield a very fair charcoal for gunpowder purposes, but from trials made of it, of late years, at the Government Powder Works at Ishapore, this is not found to be the case

Parley—Oral treaty, conference To parley in a military sense means to enter into conference with the enemy This is done by means of a flag of truce

Parole — A word published in orders every day by the officer in command of a garrison, for the purpose of distinguishing friends from foes, and without the knowledge of which no one can approach or pass by a sentry's post It is also the pass-word or order transmitted from front to rear of an army, by word of mouth Also the word of an officer under confinement as a prisoner in an enemy's camp or country, who is allowed to be at large, having promised not to effect his escape

Parrott Gun—This rifled gun is the invention of Mr R P Parrott, an American, of the West Point Foundry The cannon proper is a cast-iron piece of very light proportions, rifled with fine grooves, the circumference of the bore being equally divided between the lands and the grooves The distinctive characteristic of the gun consists in the reinforce, which is a wrought-iron ring, or hollow cylinder, shrunk round the breech at the seat of the charge This ring is only just long enough to cover the space occupied by the charge of powder and the projectile, the inventor believing that a decided advantage is gained by making the reinforce no longer than is absolutely necessary to strengthen the gun at this place Three calibres were introduced into the U S Service, *viz* 10, 20, and 30-Pr The projectile used with this gun is an elongated shell, of a length equal to 3 calibres It is cylindro-conical in form, the cylinder being very long, the base is contracted and has a brass ring fitted round it, making it cylindrical Some of the

shells are fitted with a percussion arrangement, some are fitted with the ordinary time fuze

Pass—A narrow entrance or passage between mountains In latitudes where much snow falls, the "passes" are only open for egress or ingress during the summer months

Pass—A soldier's ticket of leave, or permission to be absent from his quarters

Paste—Made of flour and alum in the proportion of 2lbs of flour to 1oz of pounded alum mixed with 1 gallon of water The mode of preparing it is as follows Heat it gently, stir it, and let it boil ¾ of an hour, when it becomes ropy, pour it into bowls, and pass it through a sieve before it is quite cold It should be used cold, and only 2 or 3 days' supply at a time made, but it may be preserved longer by adding alum in the proportion of one-tenth the weight of flour Paste is used in the laboratory in case-making, for port-fires, rockets, light-balls, &c

Pastern—That part of the leg of a horse between the joint next the foot and the hoof

Patch—The lump of metal forming the dispart sight of a gun or howitzer

Path—In gunnery, the direction of a projectile in its flight, also termed the trajectory

Patrole—A party told off from the main or regimental guard for the purpose of quelling disturbances, picking up stragglers, or any such duty as may be required of it in garrison or camp Also bodies of men moving between the line of posts to keep the one informed of the state of the other, are termed "patroles"

Paulins, Waxed — Canvas coverings waxed over for the protection of stores They are of four sizes, *viz*

Magazine, large
Magazine, small
Camel Paulins
Cart Paulins

Large paulins are used on the floors of laboratory tents Small magazine paulins are used in covering powder barrels and live shells in the batteries Camel paulins, being of a small size, are frequently very convenient, and are used for the same purposes as small magazine paulins Cart paulins are used with tilts for artificers' carts, with the exception of the camel and cart paulins, which are made of coarse country canvas, all others are made of vitry

Pauls—An Indian term for sepoys' tents They are of a different pattern to the European soldiers' tents, being smaller, and consequently much lighter

Pawl — A catch which holds a ratchet and restrains a capstan or windlass from flying round in a reverse direction during any pause in the winding

Pay Abstract—A form of document in which the pay of a company or regiment is drawn, embodying the pay of both Europeans and Natives

Paymaster — An officer of the army attached to each infantry and cavalry regiment, and to brigades of artillery other than those in India His duties are confined to paying the officers and men of the regiment, and keeping a strict account of all money passing through his hands, a statement of which he has to submit, in England, to the Control Department, and in India to the Examiner of Accounts Advances in India are made monthly or oftener from the nearest district Paymaster The pay of the artillery in

India is disbursed by the Captains of Batteries A Paymaster, on joining, has the relative rank of Captain, and his pay and rank are improved from length of service

Pearlash—Impure carbonate of potash, called in Hindustani, *Sáji Mutti* It is used for removing paint or grease

Pebble Powder—Is manufactured in the same way as ordinary service gunpowder, with the following exception Its density is greater, *viz*, from 1 75 to 1 78 It is produced by breaking up "press-cake" into lumps, which are retained between sieves of ⅝ and ⅜ inch mesh, respectively The pressure or strain exerted upon the gun by this powder is nearly half that of the ordinary R L G

Peddowk (*Pterocarpus dolbergiodies*—A tree which grows in the forests of Burmah and the Andaman Islands It resembles mahogany in its colour It was formerly much used by the Burmese for gun carriages, and was introduced, some years back, into the gun carriage manufactory at Madras A cubic foot of unseasoned wood weighs 65 to 70 lbs

Peemah (*Lagerstrœmia reginæ*) —A tree which grows in India and Burmah, and is made use of in the Madras gun carriage factory for certain portions of gun carriages It is a light and tough wood There are two descriptions of it, red and white coloured, the former is the tougher of the two A cubic foot of unseasoned wood weighs from 50 to 52 lbs

Pell-Mell—From the French adverb pêle-mêle, signifying confusedly, in disorder, in heaps, &c

Pellet Powder—This powder, in place of being made into press-cake, and then granulated, which involves the formation of a quantity of smaller grains and particles, is pressed into a number of cylindrical pellets, about 5″ long, 75″ diameter, perforated at one end to about the centre The object is to obtain a comparatively slow burning powder, having a large and uniform grain or pellet The pressure that this powder exerts on the walls of a gun is much less than that of the ordinary R L G

Pendulum — In mechanics, denotes any body so suspended that it is at liberty to vibrate or swing backwards and forwards about a horizontal axis of suspension by the action of gravity The vibration of a pendulum are called its oscillations, the time of each being counted from the time of its descent from the highest point on one side, till it attains the highest point on the other side

The lengths of pendulums vary according to the force of gravity in different latitudes, the increment above the force at the equator being nearly as the square of the sine of the latitude, and since the length of the second's pendulum is directly proportional to the force of gravity, the increment in its length above the length at the equator varies also, as the square of the sine of the latitude Hence, if 39 0265 be the length of the second's pendulum at the equator, and 0 1608 the increment in its length at the pole, the length L of the pendulum in any latitude λ, is given by the equation $L=39\ 0265+0\ 1608\ \sin^2 \lambda$

Pendulum, Gunner's—Consists of an upright frame of wood, having a cross-arm attached to it, from which a pendulum is suspended vibrating seconds, consisting of a string with a leaden ball, measuring from the point of suspension to the centre of gravity of the ball, a length equal to a second's pendulum having refer-

ence to the latitude, in latitude 22° the length is 39 1 It is used to measure the time of flight of a mortar shell.

Pendulum, Navez'—The principal part in Navez' electro-ballistic apparatus It is thus described by Captain Noble, late R A —"The principal part is the pendulum, and graduated arc The pendulum, before an observation, is held suspended by an electro-magnet, the current magnetising which passes through the first screen To the pendulum is attached, by means of the pressure of a spring, an arm with a vernier The pressure of this spring is so regulated that the arm vibrates freely with the pendulum, but at the same time it offers but little resistance to the action of a powerful horse-shoe electro-magnet, which, when the circuit magnetising it is complete, clamps the vernier arm with great firmness"

Pendulum, Sight—A graduated sine scale, by means of which a gun on an incline can be directed on an object without making any allowance for one wheel being higher than the other It consists of an upright piece of sheet brass, and has a movable slider and scale At the lower end is placed a bulb or disk, filled with lead The scale passes through a slit in a piece of steel, and is connected with it by a brass screw, which serves as a point on which the scale vibrates laterally, the slit is made long enough to allow the scale to assume a vertical position in any ordinary cases of irregularity of the ground on which the gun carriage may stand The ends of the piece of steel are formed into journals or trunnions, by means of which the scale is supported on the seat attached to the base of the breech, and is at liberty to vibrate in the direction of the axis of the piece This sight is believed to be the invention of a Russian officer, and the Americans adopted it for their artillery A similar pendulum, a few years back, was brought to the notice of the Indian Government by Captain Butt, of the late Bengal Artillery, who, unaware of the Russian invention, submitted his pendulum sight for the approval of the Indian Government, which, after trial, was reported on most favourably, and directed to be attached to all mountain pieces Captain Butt thus describes the error of the tangent scale when the carriage is on uneven ground, and the correction the pendulum sight affords —

"The line between the two sights at the muzzle and breech, being parallel to the axis of the piece, the gun (if it have a dispart sight) can always be laid correctly point blank, the error begins with the elevation, when the tangent scale is drawn out obliquely (instead of vertically as it should be), and the horizontal distance between the breech sight and the axis being greater than the horizontal distance between the muzzle sight and axis, the line of the sights produced crosses the line of the axis produced The pendulum sight starts from the same fixed point as the tangent scale, but it rises vertically, and every point on it is at the same horizontal distance from the axis that the muzzle sight is, and the line of the sights produced is always paralled to the line of the axis produced In attaching the pendulum to the gun, care must be taken that the fulcrum of the pendulum and the muzzle sight be in the same plane with, and equi-distant from, the axis of the piece"

Penetration—The depth a pro-

jectile buries itself into earth, masonry, iron, wood, &c As stated in Lieutenant-Colonel Owen's work on Modern Artillery, the penetration of a projectile depends upon a variety of circumstances, such as its velocity at the moment of impact, the charge given, its form, *density, diameter, nature of the object* struck, and the relative position of the latter with regard to the trajectory or path of the projectile Elongated shot at long distances penetrate farther than spherical, the velocity of the former not decreasing so rapidly as the latter Further, in the penetrating powers of elongated projectiles fired from rifled guns, the form of head has much to say to the disruptive effects on the object struck, and it has been found from experience that the ogival-headed shot is much more penetrating and destructive than any other form The reader is referred to the work alluded to above, for the formulæ for working out the penetrative power of projectiles into different materials

Peon — An Indian term formerly given to a foot soldier, but in these days it does not bear this signification Native servants or messengers attached to the Government offices in India are designated peons, and wear a belt with *a brass plate bearing the name of the* office to distinguish them from private servants

Perambulator — In surveying, an instrument for measuring distances, named also the pedometer and surveying wheel There are two kinds one with a large wheel, requiring two men to turn it, and the other a smaller kind, which one man can run along with

Perch — In artillery, is the beam of an ammunition or other wagon, also of a heavy howitzer, by means of which the limber of each is connected to the carriage.

Percussion—The impression made by one body falling or striking upon another Of percussive applications that we are most familiar with, is the percussion lock in small arms striking a cap, which being charged with a fulminating material, ignites, on the *hammer falling upon it, a* percussion fuze which explodes the shell on its striking an object Gunpowder, when suddenly struck, is found to be percussive

Percussion Fuze — A fuze which contains a percussive or detonating arrangement, and which bursts the shell at the moment of striking the object, without being previously ignited (*Vide* Pettman's Fuze)

Perforated Disc Gunpowder — Compressed gunpowder perforated with a certain number of holes, from the excessive pressure given to the discs, the powder burns slowly, and has been used for discharging rifled ordnance

Perigee — In astronomy, that point of the moon or a planet's orbit which is nearest to the earth

Perihelion—In astronomy, that point of the orbit of the earth, or of any planet and comet, which is nearest to the sun

Perimeter—The *perimeter of a* figure is the sum of all its sides taken together

Periphery — The circumference of any curve, as the circle, ellipse, parabola, &c

Perpendicular — When a straight line standing on another straight line makes the adjacent angles equal to one another, each of these angles is a right angle, and the line perpendicular

Persian Wheel—A contrivance for raising water from a well or stream It is extensively used in Egypt, Northern

India, the Punjab, and Sinde It consists of a wheel, about 4 feet in diameter, revolving on a wooden axle, which is flush with the mouth of the well, and is set in motion by means of a driving wheel turned by a pair of bullocks The wheel has on its rim pins of wood inserted into it, at short distances apart, to which buckets or jars are suspended by means of an endless band or double rope, the buckets descend on one side into the well and ascend on the other filled with water, and discharge themselves into a reservoir at the mouth of the well The Persian wheel used for raising water from a stream instead of a well, has the buckets somewhat differently arranged for lifting the water, but the principle is the same

Personnel—This term is applied to the officers and men of all ranks and departments composing an army or any component part of it

Perspective — In drawing, as described in Weale's Series, is the method by which all objects are pourtrayed on a plane surface, as in a picture, according to their appearance in their real situation Perspective is of two kinds, linear and aerial,—the first having reference to the form of an object, the second to its distinctness and colour

Petard—A kind of bell-shaped mortar made of bronze It was formerly a part of the equipment of an army in the field, for the purpose of bursting open gates, but has of late years been in disuse, and bags or cases of powder have been substituted for it

Petroleum—*Vide* Oils

Pettman's Fuze — A percussion fuze used in the navy in lieu of Moorsom's fuze It is now the general service percussion fuze

Pewter — An alloy of tin with lead and antimony frequently bears this name, but the best pewter was formerly made of 12 parts of tin with 1 of antimony, and a very small addition of copper

Phalanx — Peculiar to the Grecian army It consisted of a square, compact body of men, closely formed, with their shields joined, and pikes across This was called the Macedonian phalanx, and numbered about 8,000 men

Phosphorus—A highly inflammable elementary substance obtained from calcined bones, which emits light when placed in the dark, owing to its undergoing a slow combustion From experiments made last year in Belgium with phosphorus in combination with copper and tin in the manufacture of bronze guns, it was found that the increase in the tenacity of the metal by the addition of phosphorus was very great, and proved that phosphoric bronze was much harder than ordinary bronze, but it showed itself an unreliable metal, as the gun suddenly burst without giving any indication, after examination of the bore, that it was likely to do so Such an occurrence, which would not have happened with the ordinary bronze, is fatal to the use of this alloy, as no more dependence can be placed on it than on a gun made of cast-iron or steel

Photography—The art of producing pictures from nature by the action of light upon certain chemical preparations The adaptation of this beautiful art to military purposes has never extended beyond that of copying, enlarging, and reducing maps and plans But it has been shown by a Frenchman, M Auguste Chevalier, that it can be applied still more usefully to surveying

Lieut-Col Baillie, of the Bengal Staff Corps, in a lecture before the

Royal Institution in 1869, thus describes this ingenious method of surveying —"It consists in taking small circular pictures or panoramas, round each station of the triangulation into which the survey is divided These panoramas are printed by the ordinary photographic method, and are cut out and fastened on a sheet of drawing paper in the relative position to each other which they occupied on the ground to be surveyed , and straight lines or radii being produced from the centre of each through the objects shown in them, give by their intersections the relative position of each object on the paper, so that the 'filling in,' as it is technically termed, is completed as rapidly as these intersections can be found "

Such a system dispenses with the slow process of observing each object separately, and the liability to any possible error in recording the observation in the field-book, which is now quite dispensed with

Photozincography and Photolithography — The processes by means of which photographic facsimiles of original manuscripts, engravings, drawings, or letterpress may be made on the same or on any desired scale, and transferred to a zinc plate or lithographic stone, so that any number of copies may be printed off exactly in the same manner as in ordinary zincographic or lithographic printing

The utility of such a process for copying old and rare original MSS or maps and plans of all kinds for the use of engineers and others will at once be apparent, and it has already been largely adopted in the Ordnance Survey office, Southampton, for the reproduction of maps and old MS records , at the India Museum, London, for the reproduction of the patterns of Indian fabrics, and at Woolwich arsenal, for the reproduction of drawings of ordnance equipment, &c It is also largely used by the War Departments of the various European States and in America, but in no country in the world has photozincography been so extensively and so usefully applied to the reproduction of maps as in India, where skilled lithographic draughtsmen and engravers are very scarce It has been most successfully worked in the Surveyor-General's office, Calcutta, in the office of the Superintendent of the Great Trigonometrical Survey, Dehra Doon, and in the Photozincographic office of the Bombay Government at Poonah By its aid the maps of the various surveys are issued to the public within a few months after the completion of the survey, instead of being kept back for years, as they would be had they to be lithographed or engraved Besides being used in so many Government offices, this process is extensively worked by private individuals in Europe and America

Several processes of this kind have been introduced from time to time, but one of the most efficient for general purposes is that practised at the Ordnance Survey office, Southampton, and in the Indian Survey offices

It is of course impossible in a work like the present to enter into full practical details, but the following short sketch will be sufficient to give a general idea of the working of the process Those who wish for further information regarding this and other photolithographic processes are referred to the following works —

On Photozincography, by Colonel Sir Henry James, R.E Longmans, 1862

Report on the Cartographic Applications of Photography, by Lieut J Waterhouse, R A Calcutta Thacker, Spink & Co , 1870

As well as the various photographic works and journals

The process consists in printing from a suitable photographic negative on to a sheet of paper coated with a mixture of gelatine and bichromate of potash After exposure to light, the print is evenly covered with a thin coating of lithographic transfer ink, and washed in warm water to remove the unaltered gelatine in the unexposed parts, and with it the superfluous ink, while the insoluble gelatine forming the lines retains the ink, and thus a perfect copy of the original is obtained in greasy ink, which may then be transferred to zinc or stone and printed in the ordinary way The success of the operations in copying maps and drawings, &c, by this process depends entirely upon the ground of the negative being perfectly opaque, while the lines are as clear as the bare glass, and in order to ensure the best results the plans should be specially drawn for the purpose on smooth white paper in *perfectly black* ink Pale ink or washes of any colour except light blue must on no account be used The lines should be firm and clear, and the work as open as possible, and when the plan is intended to be reduced, care must be taken that the lines are drawn sufficiently thick to produce the required effect when reduced

The plan must be placed in a good light, and the camera carefully adjusted, so that the plane of the ground glass may be perfectly parallel to the plane of the plan, so as to avoid distortion, and the apparatus must be firmly fixed to prevent vibration, which would injure the sharpness of the lines The negative is taken by the usual wet collodion process, slightly modified in order to secure the greatest transparence in the lines, but as this alone will not give sufficient intensity, it is obtained by intensifying the negative in the usual way, then applying a saturated solution of bichloride of mercury till the film becomes white, and afterwards applying a dilute solution of hydrosulphate of ammonia, which instantly changes the colour of the film to a dark black or brown colour It is afterwards varnished

The next operation is to print from this negative a photograph in greasy ink which may be transferred to zinc or stone To obtain this, advantage is taken of the property possessed by alkaline bichromates of rendering gelatine, gum, albumen, &c, insoluble under the influence of light, and at the same time giving them an affinity for greasy ink

To prepare the sensitive paper, a sheet of bank post paper is coated in the dark with a mixture of from 3 to 5 parts of gelatine, 1 to 2 parts of bichromate of potash, and 50 parts of water, and hung up to dry, then coated again and hung up to dry by the other end, so as to equalise the coating Before use, the paper is passed through a glazing press to smooth the surface It is then exposed to light under a negative from 1 to 3 minutes in the sun, or until the finest lines are distinctly visible When sufficiently exposed, it is taken out of the printing frame and passed through a lithographic press in contact with a polished zinc plate which has been rolled in with thin re-transfer ink, and thus receives an even coating of greasy ink It is then immersed for a few minutes in a trough of water to soften the gelatine still remaining soluble in those parts which have not been acted upon by light It is next laid on a sloping glass slab, and washed with a sponge and tepid water till all the

unaltered gelatine is washed away, carrying the superfluous ink with it, while the lines on which the light has acted remain insoluble and retain the ink When all the details are clearly and sharply defined, and the ground quite free from ink, the print is rinsed with clear water, dried, and is then ready to be transferred to zinc or stone, just as an ordinary transfer drawing

The zinc plates used for the purpose are about $\frac{3}{16}$ths of an inch in thickness, and have one surface carefully planed and smoothed, but in order to give a somewhat porous surface to the plate, so that it may be more absorbent of moisture and greasy ink, the planed side of the plate is grained by being rubbed with very fine sand and water, the sand is sifted through a sieve of 120 holes to the linear inch After the transfers are made, the plate is etched with a preparation of gum and decoction of nut galls, to which a little phosphoric acid is added If the transfers are made to a lithographic stone instead of a zinc plate, the operations are conducted just as in transferring an ordinary lithographic drawing, except that the stone need not be heated The operations of printing, whether for zinc or stone, are just the same as in ordinary lithography

Phowra—An Indian term for a kind of spade or hoe (*Vide* Mamootie)

Phunsee (*Carallia integrifolia*)—A tree which grows in the Bombay Presidency, and in the Tenasserim and Martaban Provinces It is tough, and not easily worked It is used in the Bombay arsenals for sponge staves

Pice—A quarter of an anna, equal to three pie The commonest coin in circulation in an India bazar

Picket—To secure or fasten horses in their lines, in camp, or in cantonments This is effected by fastening the head and heels of the animal by ropes to pegs of wood termed pickets, hence the term to "picket" a horse

Pickets, Mortar—*Vide* Pointing Rods

Pickets, Inlying—Are detachments of the army told off to remain in camp, but fully accoutred, and ready to turn out instantly on alarm

Pickets, Outlying—Are detachments of cavalry and infantry, accompanied sometimes with light guns, and posted on the front and flanks of an army in the field, in order to guard against surprise, and to keep reconnoitring parties at a distance

Pickets, Park—Are small wooden posts which support the rope line round the artillery park They are carried either on carts or camels in India when on the march Dimensions—length 53 inches, and diameter 3 inches

Pickling—A process pursued in cleaning plates, iron or copper, or castings of these metals It is effected by allowing the metals to remain some hours in a diluted acid

Pie—An Indian coin representing the twelfth part of an anna

Piece—A term generally applied to all ordnance

Pierrier—A species of mortar for throwing stones, which is termed a stone mortar It was proposed that this nature of ordnance should be used beyond the third parallel, if sieges are to be conducted beyond that point, pierriers should be made light, not exceeding 10 cwt, and capable of throwing a large shell as well as stones from 50 to 60 yards

Pigs of Iron—The term applied to cast-iron run into moulds, forming semi-cylindrical bars, called *pigs*

Pike—A weapon formerly much in use, but now superseded by the bayonet The pike had a shaft from ten

to fourteen feet long, with a flat pointed steel head called the spear

Pile-driver — An engine for driving piles into the ground for the support of the piers of bridges or heavy walls, where the soil is not sufficiently firm to carry the structure, and for forming wharves or jetties The work of the pile engine is performed by a heavy block of metal about 10 cwt called the *monkey,* which being drawn up by a chain passing over a pulley at the top of the machine, falls by its own gravity upon the head of the pile This is continued until the pile is driven into the soil the required depth *Vide* Nasmyth's Steam Pile-driving Engine

Piles—Beams of wood which are driven into the ground to form a solid foundation for building For wharves and jetties, piles boarded over, form admirable landing-places and good frontage for river banks

Piles, Shot — The mode of storing shot or shell, which is either in a triangular, square, or oblong form Balls are piled according to their nature and calibre, and under cover if practicable, for though all shot and shell are painted, when exposed they are more or less subject to atmospheric influences which corrode them In piling balls, the piles should be made as narrow as possible, to facilitate a free circulation of air between the layers Prepare the ground for the base of the pile by raising it above the surrounding ground, so as throw off the water, level it, ram it well, and cover it with a layer of screened sand or charcoal Make the bottom of the pile with a tier of unserviceable shot, buried about two-thirds of their diameter in the sand, clean the base well and form the pile, putting the fuze hole of shells downwards, in the *intervals,* and not resting on the shells below The base may be made of brick or stone Canister should be piled in store-rooms on the ground floor

Balls should be painted or lacquered as soon as possible after they are received, and when re-painted the old paint should be scraped off

To find the number of shot in a triangular pile —Multiply the number in the base by the same + 1, and this product again by the base + 2, and divide by 6

To find the number in a square pile — Multiply the corner row by the corner row + 1, then this product by twice the corner row + 1, and divide by 6

To find the number in an oblong pile — From three times the length of the base + 1, subtract the breadth, and this product by the breadth + 1, and divide by 6

In an incomplete pile, according to either of the preceding rules, find the number in the pile considered as complete, then the number in the upper part, and the difference between the two piles will be the number in the incomplete part

The above calculations are for spherical shot

Oblong shot and shell (Armstrong) are piled in rectangular piles

$s = (2n + r - 1)\frac{m\ r}{2}$ where n = number in length of top course, r = number of courses, m = number in breadth But the following formula has been recommended for elongated projectiles, as communicated by Captain R O'Hara, R A, to the Royal Artillery Institution

Let B = number in breadth of pile

L = number in length

$$S = \frac{B\ L}{2}(B + 1)$$

Pillar Fuze—This fuze (now obsolete) was used with all the heavier natures of Armstrong's shells, and is a concussion fuze.

Pin—A short piece of wood or metal.

Pincers, Gun—An instrument used for extracting a bit or drift from the vent of a gun.

Pincers, Tong—Used by the blacksmith for gripping bolts.

Pinching—Is the operation of moving a gun or mortar by small heaves of the handspike, without allowing it to turn on its axis. It is moved little by little, and rubs against the skid on which it rests.

Pinion—In mechanics, a spindle, in the body of which are several notches, into which the teeth of a wheel catch which serves to turn it round; it is also the name of a lesser wheel which plays in the teeth of a larger one. (Weale.)

Pintail or Pintle—A hook attached to the rear of the limber axle-bed of a light field carriage, to enable the gun or ammunition carriage to be limbered up to it. In this position the gun forms a counterpoise to the weight that would otherwise rest on the shafts. It is calculated that the weight on the horse's back of a fully packed limber, with the hook fixed to the axle-tree bed, averages about 75lbs. In heavy howitzers and siege carriages formed with bracket sides, the pintail is either a stiff or movable iron perch, attached to the top of the limber axle-tree, to which the gun carriage is limbered up by a hole passing through the rear transom; this mode of limbering-up is necessary, in consequence of the weight and dimensions of the trail.

Pioneers—Are a small body of men (one per company) attached to each infantry regiment for the purpose, whilst on the march, of clearing the road, and cutting down all obstacles, such as trees, jungles, &c., as may be found necessary for the onward progress of the regiment or army. Each pioneer, besides carrying a tool of some description, carries a saw-backed sword, which serves both as a weapon and a tool.

Pipe, Trace—The leather pipe or covering of a horse trace.

Pistol—A species of firearm, of which there are an infinite variety, from the single and double-barrelled pistol to the many-barrelled revolver. The pistols furnished to the cavalry are rifled, having a calibre of ·577 inches.

Piston—A movable air-tight division within the steam cylinder, acted upon by the steam. Pistons are either metallic or packed. Metallic pistons usually have segments of brass or cast-iron, called junk rings, pressed outward by springs. Packed pistons are surrounded by well-greased hemp. (Weale.)

Piston-rod—The rod fixed to the piston to communicate its motion to the crank. This rod is turned exactly circular, and passes through a circular hole in the centre of the cap of the cylinder, the hole being made to fit the rod so exactly as not to let the steam escape, and to move at the same time so freely as to require very little power to urge it.

Pit-charcoal—Wood charred in a pit instead of in closed retorts. The operation is performed as follows. From 3 to 4 cords of wood (a cord of wood measures $14 \times 3 \times 3$, or 126 cubic feet) are built up in a circular mound about 10 feet in diameter, and 5 feet high, having a hole left in the centre which acts as a chimney. The mound of wood is then covered with stubble or

straw, 3 or 4 inches deep, and over these a layer of charcoal dust or sand about the same thickness Lighted charcoal is put down the chimney, which is closed up The process of charring then commences A shifting screen is always placed to windward to regulate the draught, and small holes are left at intervals to allow of the escape of the vapour After three days and nights the operation is completed Pit-charcoal is used for firework composition, and also as an ingredient in the manufacture of pit-powder

Pitch—Made by boiling tar down to the requisite consistency, either by itself or combined with a portion of rosin, it becomes solid on cooling, but is soon softened by the heat of the hand, in which state it is very adhesive When of good quality, it is clear and hard It is used in making carcasses, light-balls, kitt, and smoke-balls

The term is used in wheel-work, signifying the distance between the centres of two contiguous teeth Pitch-line is the circle concentric with the circumference which passes through all the centres of the teeth

Pitch of a Screw—The interval between the points of starting and arrival of a complete revolution of a screw, and consequently of the thread of a screw, which is traversed by the screw, or its thread, when it has completed an entire revolution The pitch is therefore independent of the diameter of the screw

Pitching a Tent—*Vide* Bush

Pit-saw—This instrument is used in sawing up timber at the pit It is worked vertically by two men, called the *top-man* and the *pit-man*, the former of whom stands upon the piece of timber about to be sawn The pit-saw is about 6 to 8 feet in length, according to the size of the timber To adapt it to the hands of the sawyers, it has at the upper part a transverse handle, or *tiller*, and at the lower a box The introduction of circular saws, driven by steam, has to a great extent done away with the cutting up of timber by hand-work

Pits, Charger—Pits dug in rear of a shelter trench for the protection of the mounted officers of a battalion They are generally excavated 20 paces in rear of the line taken up Each pit should be about 5 feet long, 3 feet wide at the top, and 2 feet at the bottom, with ramps at a slope of ½ at the ends Such a pit can be dug by four men in half an hour

Pits, Gun—Are for the protection of artillery in the field and before the enemy The guns may be often covered from the enemy's fire by natural banks, crests of hills, sand mounds, &c , but if there is no natural cover, resort must be had to the pickaxe and spade A gun-pit can be excavated in one hour by experienced men This gives but a limited space to the gun detachment, so if there is time, the pit can be lengthened, and the thickness of the parapet increased Since isolated gun-pits, as explained in the 1st Vol of "Instruction in Military Engineering," would form good marks for the enemy's fire, it would be advisable to connect them by shelter trenches, in which, however, places should be left to enable the guns to pass readily to the front Should no natural cover whatever be available for the limber, cover for it and a pair of horses might be provided in a pit, somewhat of the form of a charger-pit, and similar arrangements should be made for the cover of more horses

Pits, Rifle — May either be *detached or connected* The former are made to contain one man, and is in the

shape of a frustum of a cone with a seat in rear As further described in the "Instruction in Military Engineering," from which the above is extracted, the diameter at top and bottom respectively is 4 feet 6 in, and 2 feet 6 in, while the depth is 4 feet, the amount of excavation (including the seat in rear) being 39 cubic feet, a man should complete one in an hour, requiring a pick-axe, a shovel, and four sand-bags

The dimensions of the connected rifle-pits are 5 feet long, 4 feet wide, and 3 feet 3 in deep, a seat 1 foot 6 in wide and deep is cut in rear The pits are placed about 30 feet from each other, and are connected by means of a trench The position of both kinds of pits is, in active operations, in advance of the works previously constructed, that the fire from them may keep down that of the enemy, and thus allow of the subsequent works being constructed with as small a loss as possible. They should be arranged, if practicable, so that they may be afterwards connected into parallels Sap-heads should be covered by detached rifle-pits, 30 or 40 yards in advance

Pits, Shelter—Are for the protection of skirmishers, which the men should be able to make for themselves In most instances, as described in the "Instruction in Military Engineering," the men will only have to improve natural cover, but it may be necessary to dig small pits which may be called *shelter pits,* in contradistinction to the larger pits required at sieges, &c, which are called rifle pits Each shelter pit should be for one man only Such a pit may be made in about five minutes, the depth need not be uniform, but should be about 10 inches where the man's body will be, and about 6 inches in other parts

Pivot—A point, fixed or movable, on which a body turns It is applied to that point on which an axle turns, to the pivot of the nut of an elevating screw, to the fixed or halted pivot of a company of soldiers at drill, &c The application of the term is endless

Plan—In fortification, shows the tracing, also the horizontal lengths and breadths of the works, the thickness of the ramparts and ~~parapet,~~ the width of the ditches, &c It exhibits the extent, division, and distribution of the works, but the depth of the ditches and the height of the works are not represented in a plan

Plane—In carpentry, a tool used by the carpenter or joiner for taking the rough surface off the timber to be smoothed in surface The plane is a chisel inserted in one of the several forms of stocks or guides, the general objects being to limit the extent to which the blade can penetrate the wood, to provide a definite guide to its path or direction, and to restrain the splitting in favour of the cutting action

Planes are distinguished by their names, length, &c, and the peculiar work they are intended to perform, and are classed as follows Bench planes, grooving planes, and moulding planes Among the bench planes are included the jack, rebate, smoothing, and trying planes The succession in which they are used is as follows the jack for the coarser work, the trying plane for the finer, and the smoothing plane for finishing The jack plane is what is termed a full-length plane, furnished with a handle, or *toat* The smoothing plane has no handle, and is shorter than the jack plane The filister and plough planes are termed grooving planes, the former, intended to plane both with

and across the plane, as in planing a rebate around the margin of a panel, the latter, to work with the grain,—it has similar powers to the filister, but with a greater horizontal longe

Plane — In Geometry, denotes a plane figure or a surface lying evenly between its bounding lines

Plane, Horizontal — Is a plane that is level or parallel to the horizon

Plane, Inclined—Is one which makes an oblique angle, with a horizontal plane The simplest form of inclined plane is to be seen in cutting a wedge through lengthways

Plane of Fire — The vertical plane passing through the axis of the gun

Plane of Site — In fortification, the general level of the ground or ground line upon which the works are constructed, whether that plane be horizontal or oblique to the horizon

Plane Table — An instrument much used in land-surveying, by means of which a plan is made on the spot, without any after-protraction or plotting It consists of a plane rectangular board of any convenient size, generally about sixteen inches square, the centre of which, when used, is fixed by means of screws to a three-legged stand, having a ball and socket, or universal point, at the top, by the aid of which, when the legs are fixed on the ground, the table is inclined in any direction, but can be set horizontal by means of a circular spirit level A compass box, with a magnetic needle, is screwed into one side of the table to indicate the bearings, and to enable the surveyor to set up the instrument at a new station parallel to the position which it had at a former one

A brass rule or index with a sloping edge, and having perpendicular sight-vanes erected at each extremity, completes the apparatus

Plane, Vertical— A plane passing at right angles to the horizontal plane

Planimeter—An instrument for calculating superficial areas on paper, used in the Survey Department

Planing Machine — Is an application of the slide-rest to plane surfaces In the planing machine the work is firmly bolted to a table sliding in dove-tail grooves, and travelling backwards and forwards under the cutting tool, which admits of accurate adjustment When one end of the work has escaped from under the tool, the table is moved back, and the slide-rest is moved a little way across the table, so as to take off the next shaving close to the one previously cut It is necessary to keep the tool cool during the work, by allowing cold water to drip upon it, otherwise the edge would soon become soft

Plank — A term applied to all superficial timber which is 4 inches thick and under, except 1 inch and sometimes 1½ inch, which come under the denomination of "board"

Plant—Used in a military sense, signifies to place, to fix,—as, to plant a standard, to plant a sentry

Platforms, Gun — Are necessary for the efficient working of heavy ordnance, whether on siege or garrison service By being thus provided, guns are worked with greater ease, expedition, and accuracy

Siege platforms are made of wood, and of such a weight as to render them easy of transport There are several patterns in the service, such as the Common, Alderson's, Clerk's, and Madras platforms Some of these patterns are especially used for guns, others for mortars

The garrison platforms are of two sorts, — ground and traversing The former is used in permanent fortifications, and is made of stone and has a slope of 1 in 15, the latter, for a siege gun, is of wood, and has a slope of 1 in 24 The object of this slope is to check, to a great extent, the recoil of the piece Mortar platforms are laid perfectly horizontal Wooden, or siege platforms, are composed of sleepers, planks, ribands, rack sticks, and lashings the two latter are used when the platform is secured by means of them, instead of by bolts In laying platforms, the lashing rope is first put down, and then the sleepers, after which the space between the sleepers is filled up with earth, and well rammed, the planks are then laid on, and the ropes drawn through the slits in the ends of the planks, after which the ribands are put on and tied Fascines are fixed across the front of platforms as hurters, to prevent the wheels coming forward against the merlon The common platform weighs 13½ cwt

Platforms, Traversing — Are of three kinds, *viz* common, dwarf, and casemate Common traversing platforms are employed to raise guns sufficiently high to enable them to fire over a parapet, and they are made of either wood or iron They have been superseded by dwarf traversing platforms Wooden traversing dwarf platforms are similar in general construction to the common traversing platforms, and guns mounted upon them can fire through ordinary embrasures By lengthening the legs of a platform of this kind, the gun could fire over a parapet, if required The ordinary garrison carriage is used with this platform, but has blocks instead of axle-trees, upon which it rests on the platform, the part of the block between the cheeks being deeper, and passing between them so as to keep the carriage in its place In front of each bracket there is a pair of check-plates, in which a gun-metal truck works, which comes into play, when the rear is hoisted up by the truck levers, the carriage is run up by means of tackle The platforms traverse on raised racers, resting on hollow solid trucks which run upon the racer Since the introduction of heavy M L rifled guns, wrought-iron traversing platforms, case-mate and dwarf, have been introduced into the service

Platforms, Wagon — Carriages on four wheels, used for the transport of guns, mortars, traversing platforms, and for every description of heavy stores

Platoon—This word is derived from the French *peloton* It was used some centuries ago to represent a small body of musketeers, who were placed at the angles of a square of infantry or were used as skirmishers At the present day, the term is only known to distinguish the manual from the platoon exercise in the drill of the musket

Plotting—Transferring to paper the dimensions of the different angles and measurements made by a surveying instrument in the field

Plough—A wooden wedge or shoe shod with leather It is attached to a gunpowder incorporating mill, for confining the charge under the path of the runners There are two attached to each pair of runners

Plug—Anything used to stop an orifice or hole In artillery material there are a variety of plugs, which are chiefly required for the different natures of shells There are two classes of plugs, known as fuze-hole and loading-hole plugs They are made of gun metal

Plug for Oil Hole.—In the breech end of all Armstrong guns, excepting the 110, 40 (new pattern), and 9-Prs., directly at the back of the ratchet or point-blank sight, a hole is drilled for lubricating the thread of the breech screw.

A steel plug is used to fill this, so as to prevent any dirt or grit getting in which would be likely to affect the efficient working of the breech screw, and injure the thread. A small spring is attached to this plug to prevent its being shaken out when firing or in rapid transit over rough ground, and it can be removed by the tommies mentioned in the list of smith's tools.

Plummer Block.—The carriage or support for a bearing to turn in, which is generally made of gun-metal.

Plummet.—Used by masons, carpenters, &c. It consists of a line with a weight attached to it (a leaden ball generally) to regulate any work in a line perpendicular to the horizon. Another application of the plummet is in laying a mortar; it is further used to indicate the time of flight of a mortar shell.

Plunging Fire.—When a battery is raised considerably above the object, so that the shot impinges at a great angle, and is buried without grazing, it is termed *plunging fire*.

Pluviometer. — A rain gauge, an instrument to measure the quantity of rain that falls. It consists of a copper funnel from 5 to 7 inches in diameter, the rain being collected in a glass bottle. This bottle should be placed in a small stand near the surface of the ground, to protect the bottle from the action of the sun. The amount of rain fallen in a given time is measured in a graduated glass jar, one-tenth the area of the funnel, and so divided that every inch in depth of the tube shall indicate one-tenth of an inch falling in the funnel. The amount of rain falling can be measured by such an instrument to $\frac{1}{1000}$th part of an inch, or even less.

Another kind of rain gauge may also be adopted. It consists of a cylinder of copper or other metal, from 5 to 7 inches in diameter, and 30 inches long. A float, just so much smaller as to allow it to rise freely, is placed within the cylinder, and to the centre of the float is attached an upright staff, marked in inches and tenths of an inch, which, rising through a hole in the bottom of the funnel, indicates the depth of rain received into the gauge.

Pneumatics.—The properties of air or fluids; a branch of hydrostatics.

Point-blank.—A gun is said to be laid point-blank when the production of its axis passes through the object aimed at; a gun may therefore be "point-blank" with reference to an object, and yet have several degrees of elevation or depression, with regard to the horizon.

Point-blank Range. — This term, as shown by Col. Lefroy in the R. A. Institution Papers, is a misnomer. What is usually called "point-blank range"—*viz.*, the distance at which a shot impinges on a level plane, when fired parallel with it,—is nothing more than the range due to an "angle of elevation" equal to the angle subtended by the height of the gun from the point struck.

Point d'appui.—A fixed point of support in rear of the operations of an army, such as a fortress or some convenient locality to resort to in case of necessity.

Point of Impact. — Is that point or spot which a projectile first

strikes, on meeting an opposing body *Vide* Impact

Pointing—In gunnery, the art of laying guns *Vide* Lay

Pointing—To "point a rope" is to taper one of its ends, so that it can more easily enter a hole or block

Pointing Rods—Or "pickets," are rods of iron ⅝ inch round, and about 2 feet long, two of which are placed upon the epaulment of a battery in front of each mortar, by means of which, with the aid of a plummet, the mortar can be directed with tolerable accuracy upon the object to be struck

The pickets are first lined upon the object, the plummet, which is in the hands of the laying officer who stands behind the mortar, is made to coincide with them, and the mortar is then traversed until the line of the plummet covers the centre line on the mortar, which is denoted by a notch on the muzzle, and another behind the vent, a chalked line being generally drawn on the exterior surface of the mortar between these notches In masonry works, they must be placed on a fir plank, of about one foot wide, four feet in length, by three inches thick, and about six inches from each end The plank should be fitted with a grummet or handle at each end In earth-works, two ramrods will answer for pointing rods These pointing rods may now be said to be out of date, as Davidson's Collimator is a more convenient and truer way of laying a mortar

Polarity—The opposition of two equal forces in bodies, similar to that which confers the tendency of magnetized bodies to point towards the magnetic poles

Polarized Light—Light which, by reflection or refraction at a certain angle, or by refraction in certain crystals, has acquired the property of exhibiting opposite effects in planes at right angles to each other, is said to be *polarized*

Pole—That part of a gun or ammunition carriage to which the wheel horses are attached Poles are now abolished, shafts for horse draught alone being used For carts and all extra carriages drawn by bullocks, as in India, the pole is indispensable

Polygon—A plane geometrical figure having more than four sides Every piece of ground to be fortified is surrounded by a polygon, either regular or irregular, upon the sides of which the work is constructed

Poniard—A small pointed dagger

Pontoons—Are either light open boats of wood or metal, with flat bottoms, upon which a road-way of planks is formed for the transport of an army across a river, or cylinder-shaped with hemispherical ends, such as General Blanchard's pontoons, which are the pattern pontoons used in the British army They are of two kinds, large and small, the latter for the passage of infantry Though several kinds of pontoons have been introduced into the European armies, a perfect pontoon bridge equipment, combining facility of transport with quick means of passing armies over considerable rivers, does not seem yet to have been organized In India, country boats have generally been available in most of the rivers which armies have had to cross, and which, combined with engineering skill, have always formed an admirable passage for the transport of troops Corrugated iron carts, if in sufficient number with an army, might be turned to good account as pontoons

Casks, if available, form a very good bridge, being first of all formed into *piers*, the piers are then

formed into a bridge in much the same way as pontoons, or boats, would be Barrel piers can be formed of any number of casks from two upwards For the mode of throwing a pontoon or cask bridge across a river, *vide* "Instruction in Military Engineering," 1870

From experiments made at Woolwich (*vide* R A Institution Papers, vol 3) it has been found that the vertical pressure of guns, when passing over pontoon bridges on travelling carriages with their full equipment of stores, is greater while moving than when stationary, to the following extent, with the undermentioned ordnance —

40-Pr	Armstrong	30	per cent
18-Pr	Smooth bore	26	do
20-Pr	Armstrong	30	do
12-Pr	Armstrong	50	do
10-Inch mortar		46	do

The high rate of increase obtained with the 10-inch mortar, as compared with the 18-Pr and 20-Pr, is due to the low wheels of the mortar carriage, and that observed with the 12-Pr in comparison with the other guns, is probably due to the horses, between whose weight and that of the carriage there is not so great a difference as exists in the other carriages

Poppet-head—That part of a lathe which holds the back-centre, and can be fixed on any part of the bed Boring-machines have a poppet-head

Portcullis—A strong defensive framework of timber, hung in grooves within the chief gateway of a fortress, it resembles a harrow, but is placed vertically, having a row of iron spikes at the bottom, and is let down to stop the passage in case of assault

Port-fires—Are used to fire ordnance, and were in general use before the introduction of friction tubes, but since then have been to a great extent in disuse, a certain proportion, however, still accompanies each battery. Port-fires are of two different natures as used in the artillery service, *viz*, common and slow port-fires, but only the common port-fire is used in India The common port-fire consists of a paper case, about 16 inches long, into which is driven a composition, which burns at the rate of one inch in a minute A port-fire is considered unserviceable when the paper is unpasted, torn, or otherwise damaged, or if the composition is soft or broken

The slow port-fire consists merely of paper impregnated with saltpetre, and rolled into a solid cylinder about 16 inches long, and burns from three to four hours

Port-fires, Coast-Guard — These are generally fitted by the coast-guard with a contrivance for lighting them by percussion

Position (Battery of)—Consists in India of three 40-Pr Armstrong guns, two 8-inch, and two 5½-inch mortars These batteries of position follow the movements of the army, and are available for any position they may be called upon to take up They are equipped like field batteries, and are drawn by elephants

Post, Military—Any spot of ground occupied by troops The importance of strengthening a position is admitted to be of paramount importance, and every endeavour should be made by the officer in command to place himself in such a defensive position as shall prevent his post being taken unawares, or, if attacked, enable him to make a good fight of it Often neither time, material, intrenching tools, or men will permit of solid works, such as a redoubt or other elaborate field works being thrown up, but it is possible,

when villages or detached houses are occupied by troops, to throw up temporary cover which shall greatly strengthen the position The mode of carrying out such a system of defence should be known to every officer in the army

The following are the principles to be borne in mind in forming a military post or in strengthening a position, extracted from the "Instruction in Military Engineering" —

"1st —To obtain cover for the men from the enemy's fire

"2nd —To enable the troops to fire in the most advantageous manner, on the ground over which the enemy must advance

"3rd —To hinder the approach of the enemy by obstacles, which, even if surmountable, shall be sufficient to break his order and to detain him for some time under fire

"4th —To enable the troops to pass freely from one part of the works to another, in order to concentrate on any point attacked

"5th —To impede the flank movements of the enemy as much as possible, and thus prevent his different parties from supporting each other effectually"

Postern — A vaulted passage of masonry constructed underneath the mass of the rampart to communicate from the interior of a work into the ditch before it Posterns are usually from 5 to 9 feet wide, and from 6 to 7 feet high at the crown of the arch, and are closed at each extremity by doors

Potassa—*Vide* Nitre

Pouch, Small-arm — A leather case lined with tin, and covered by a flap for carrying a soldier's ammunition In the manufacture of pouches, buffalo hide is generally used

Pounce—A stone bearing that name, which, when reduced to powder, is formed into paste, and used in public offices as an adhesive for letters

Pounder—The name by which different natures of ordnance are distinguished, such as the 24-Pr, 18-Pr, &c By being so denominated, the weight of the projectile which the gun throws is implied Projectiles fired from shell guns, howitzers, and mortars, are distinguished by the diameter of the pieces, such as the 10-inch, 8 inch howitzers, mortars, &c, and it would be advisable to denominate all projectiles by the diameter of the piece, and also by the weight of the projectile itself This is done in the case of shot and shell used with the heavy M L rifled guns of 7-inch calibre and upwards, but guns below 7-inch calibre are known only by the weight of the shot The weight of heavy rifled ordnance is always expressed in tons, if of 5 tons or upwards, otherwise in cwts

Pozzuolana—A volcanic sand brought from Italy, which forms a cement that hardens under water *Vide* Soorky

Pratique—Permission given to a ship which has performed a limited quarantine to enter port, on the commander assuring the authorities of the port that no infectious disease exists on board his ship

Precipitation — In chemistry, is most frequently employed for the separation of substances from each other This operation consists in the conversion of one constituent part of a liquid into a solid form, when it may be separated by mechanical means, this may be effected either by changing the chemical nature of the constituent to be separated, or that of the liquid in which this constituent is dissolved

Preponderance—In artillery,

the excess of weight in a gun in rear of the trunnions As applied to modern guns, it is the pressure which the breech portion of the gun, when horizontal, exerts on the elevating arrangement A certain amount of "preponderance" is necessary in all guns, in order that they may rest steadily on their carriages, but it is desirable that it should be as small as possible, to avoid unnecessary labour in raising the breech of the gun, when it has to be elevated The preponderance varies in different guns in the service, in smooth-bored guns between one-ninth and one fifteenth of the total weight of the piece In rifled M L guns of the heavier natures, such as the 9, 8, and 7-inch, the preponderance is between 5 and 6 cwt, in guns of 18 tons and upwards, it should not exceed 3 cwt

Preservation of Iron Ordnance—Great attention should be paid to the preservation of iron ordnance, to prevent the injury which guns sustain from rust or corrosion With smooth-bored ordnance, the first step to be taken is to clear the bore and exterior surface from rust and dirt, the inside is cleansed with circular spring scrapers, fixed on the end of a long shaft, they are made to press on the sides of the cylinder, and by being drawn backwards and forwards, will restore a regular smooth surface, the end of the bore is also scraped with a tool for that purpose The vent is opened by turning a square steel rimer through it, until it is clear The bore is then brushed out with a hard round brush, and then with a *Turk's-head* brush, so that no residue be left This done, a coat of lacquer is to be laid on, and when dry, a second is added, which is performed by a common paint brush fixed vertically on the end of a staff long enough to reach down the bore, the bottom of the bore is lacquered by a brush attached horizontally to the end of the staff The outside of the piece is to be well scraped with a tolerably sharp steel tool, about the mouldings where former coatings have collected, and where the rust will not give way, it should be slightly hammered, so as to loosen it The pieces should not be removed until the paint is quite dry The painter should mark the date, to show how long the lacquering lasts

Where anti-corrosion paint was formerly used for lacquering the exterior and bores of guns, Pulford's magnetic paint is now used

Press-cake — The solid dense substance which gunpowder assumes after being subjected to hydraulic pressure Press-cake, after being taken out of the press-box, has a dampish appearance which soon leaves it, when it may be likened in hardness to slate

Preventor Ropes—Are used in the artillery service to check any motion which is liable to become too rapid,—such, for instance, as the recoil of a gun

Primers—Are used with the 40-Pr and 7-in screw and B L guns, and are introduced into the horizontal part of the vent before the vent piece is placed in the gun, the object being to communicate the flame from the friction tube to the cartridge, the length and form of the vent holes being such that the friction tube alone will not readily ignite the cartridge

A primer for use with Boxer's shrapnel shells for rifled guns has been approved of It is for the purpose of securing the bursting charge, and to give greater regularity to the bursting of the shell

Priming of a Gun—Is the powder which is poured into the vent,

with the view of its communicating with the cartridge This mode of priming was the usual method before the introduction of friction tubes, and when the priming was ignited by means of a port-fire In the preparation of fuzes, carcasses, &c, a priming is used to assist in igniting them

Principals—The sloping beams of a roof (*Vide* Tie-Beam)

Pripole or Prypole — The front leg of a gyn

Prismatic Compass — A surveying instrument, by means of which horizontal angles can be observed with great rapidity, and when used with a tripod stand, with a considerable degree of accuracy It is consequently a very valuable instrument to the military surveyor, who can make his observations with it, while holding it in his hand, with all the accuracy necessary for a military sketch (*Vide* Heather on Instruments)

Private—A term used in the British infantry to express a soldier in the ranks A corporal, though numbered among the rank and file, does not come under the denomination of *private*

Prize-Agents—Officers belonging to an army in the field, who are chosen after a campaign to collect all property belonging to the enemy which has fallen into the hands of the victors If the prize property be considerable, it is a lucrative position, as a certain percentage on what is collected is granted to the prize-agents

Profile—If a plane pass through a work in any direction, and the cut made be vertical and perpendicular to the face of the work, it is a *profile*

Projectiles — Shot and shell of all natures The projectiles fired from smooth-bored cannon are of a spherical form, and those from rifled guns have an elongated figure Projectiles for heavy rifled muzzle-loading guns are rounded at the base

Prolong—A four-stranded rope, upwards of an inch in diameter, and 72 feet in length, with which field artillery is provided, to enable it to fire while retreating, without the necessity of limbering and unlimbering

Promotion—In the army, with certain exceptions, promotion has hitherto been carried on in the cavalry and infantry chiefly by purchase, but this for the future is likely to be discontinued, and promotion regulated by efficiency and selection The Artillery and Engineers have always been non-purchase corps

Proof of Gunpowder—Gunpowder, after manufacture, is tested both as regards its quality, strength, and uniformity The former is ascertained, both small and large grain, by its general appearance, its firmness, glazing, uniformity of grain, and density The weight of a cubic foot of Government powder varies according to the nature of the powder, for which there is a maximum and minimum limit The process of "flashing" is also resorted to for testing the cleanliness and intimate mixture of the ingredients With this view about 3 drachms of powder are placed on a glass plate, and fired with a red-hot iron, when, if the powder has been properly made, no residue or foulness should be left

The strength and uniformity of all powders are proved by Navez-Leur's Ballistic apparatus,—cannon powder from a 9-Pr gun, and musketry powder from a breech-loading rifled musket In addition to the above proof, the hygrometric test is a very necessary one to be taken of all natures of powder

Proof of Ordnance — The test ordnance is put to after being manufactured. In proving smooth-

bored ordnance, the piece is first thoroughly cleaned inside and outside, and then examined for flaws or holes with a spring-searcher The calibre and concentricity of the bore are then tested with Desaguilier's instrument, and the several exterior diameters are gauged with bore callipers The length of the piece, bore, and trunnions is now measured, and the true position of the latter tested

The piece now undergoes the powder proof, *viz*, two rounds with a heavy charge, and one service shot pressed home with a junk wad, or wooden wedges

After this, it is submitted to the water test which is performed by water being forced into the bore through a plug in the muzzle, with a pressure of 100lbs on the square inch, and should any portion of the metal be spongy it will be detected by water showing itself through the metal, technically termed *weeping*

Lastly the gun is examined with a lamp passed down the bore to see that it has not been indented in proof, and that it is sound in all respects

The proof of rifled guns, taken from Captain Stoney's Paper "On the Construction of our Heavy Guns," is carried out as follows —

"Gutta percha impressions are taken of the whole length of the bore in the four quarters The gun is then proved with two rounds—the projectile being equal in weight to the service one, but flat-headed for 7-inch guns and upwards, in order that it may penetrate as little as possible into the butt, and the charge being 1¼ the weight of the battering or highest charge used in the service The gun is fired in the open by means of an 'Abelic' electric tube connected with a magneto-electric battery in a bomb-proof shed After proof, water is force-pumped into the bore, with the pressure of 120lbs to the square inch This was instituted for guns with wrought-iron barrels to ascertain that the breech was perfectly closed, and is still continued in the case of solid-ended steel barrels, to make sure that the end has not been split in proof After this the gun is cleaned, and gutta percha impressions of the bore being taken as before, the two sets of impressions are compared to ascertain that no flaw of a serious character has been developed by proof If any defect appears of which there is even the slightest doubt, the gun is subjected to five more rounds with service charges, and if after that the flaw does not appear to have increased, the gun is passed"

The system of proving bronze guns hitherto in force, has been to fire them when completed, with the regulated charge of powder and shot, *viz*, one-third the weight of the shot, three rounds being fired they were then subjected to hydraulic pressure, which consisted of endeavouring to force water through the metal by means of an engine placed in the mouth of the gun The French mode of proving guns, however, has now been introduced into the British service, which consists in boring the piece to a diameter less than the true calibre by 2 millimetres or (0 0787-in)* and then subjecting it to the proof of fire and water If the indentations are of such a depth as not to disappear when the piece is bored up to the true calibre, or if the piece leaks, it is condemned

Protractor—In surveying, an

* The Ordnance Select Committee's Instructions are 0 08 in

instrument for laying down on paper the angles taken in the field

Protractor, Semi-circular —An instrument used for measuring the inclination of the vent of a piece of ordnance

Provost-Marshal — Is a functionary vested with powers of a special and extraordinary nature, the offspring of the exigencies of armies in the field

"The Queen's Regulations" define the position and duties of a *Provost-Marshal* as follows —

"The officer appointed to the situation of *Provost-Marshal* has the rank of Captain in the army the appointment is one of great responsibility, and requires the utmost vigilance and activity It is the particular duty of the Provost-Marshal to take charge of prisoners confined for offences of a general nature, to preserve good order and discipline, and to use every possible means to prevent the commission of crime, by frequently visiting those places at which breaches of order and discipline are likely to be committed, he is to take cognizance of the conduct of all followers and retainers of the camp, as well as of the soldiers of the army

"With this view, he is frequently to make the tour of the camp, and its environs, in order to prevent, and detect persons committing acts of disorder or depredations

"The Provost-Marshal is intrusted with authority to inflict *summary* punishment on any soldier, or individual connected with the army, *whom he may detect in the actual commission of any offence against order and discipline*, but a recourse to the exercise of this part of his authority is to be limited to the necessity of the case, when the prevalent and continual commission of any particular offence may call for an immediate example The duties and powers of a Provost-Marshal are defined in the Articles of War

"Plundering and marauding, at all times highly disgraceful to soldiers, under the circumstances in which the army would take the field in any part of the United Kingdom, and committed against the persons and properties of our own countrymen, whom it is our duty to protect, become crimes of such enormity, as to admit of no remission of the awful punishment which the military law awards against offences of this nature The Provost-Marshal, in making his rounds, will be authorized to execute it immediately, and in its greatest rigour, against all such as are detected by him in the fact

"General officers commanding divisions and brigades, and the staff officers attached to them, are to give their particular attention to the conduct of the Provost-Marshal and of his Assistants, and to take care that every requisite aid be given to enable them to discharge their duties with proper effect,—at the same time that no abuse, or improper application may be made of the authority intrusted to them

"Officers in the command of guards or detachments are to give assistance to the Provost-Marshal in the execution of his duty, and any officer or soldier impeding him in the same, or offering him any insult, will receive the most exemplary punishment

"The regiments encamped near villages are to send frequent patrols into them to apprehend such persons as may be there without passes, or who, having passes, may behave improperly

"The followers and retainers of the army are subject, equally with soldiers, to the provisions of the Mutiny Act and Articles of War"

Prussian Rifled Gun—Is a breech-loading gun, the arrangement for closing the breech being similar to that of the Wahrendoff gun, a paper wad is however used, which is shaped like the lid of a canister and fits over the back of the cartridge, so that when the piece is discharged, the wad is forced by the gas against the bottom of the bore, and thus prevents any escape of gas at that part, the wad remains in the piece when discharged and is afterwards pressed by the rammer through the bore, which it therefore cleans out The safety of the breech loading apparatus is said to be due entirely to this wad The grooves are flat, and about $\frac{1}{16}$th of an inch deep, their number varying from 12 to 18, according to the nature of the gun The twist is about 1 in 25 ft The projectile is made of cast iron, surrounded with leaden rings, the diameter of the latter being greater than that of the bore The projectile is intended to act as shot, shell, shrapnel, or case The Prussian field guns are breech-loaders made of steel, and those used in the late war with the French were the *canon de* 4 *rayé*, projectile weighing 9 lbs, and *the canon de* 6 *rayé*, the projectile of which weighs 15 lbs

Prussian Rifled Musket—*Vide* Needle Gun

Puddling—In metallurgy, a process in the refining of iron which consists in stirring the metal actively about, when in a state of fusion

Pukhal—An Indian term for a leathern water-bag, commonly carried on bullocks or mules

Pukhali—A waterman

Pulford's Magnetic Paint—Now universally used instead of anti-corrosion paint for lacquering iron ordnance

Pulley—One of the six mechanical powers The pulley is a small wheel movable about an axis passing through its centre, in the circumference of the wheel is a groove to admit a rope or flexible chain Pulleys are of two kinds, fixed and movable, according as their axes are fixed or movable In the fixed pulley, the power is equal to the weight In the movable pulley, the power is to the weight as the radius of the pulley is to the chord of the arc enveloped by the rope, or, in other words, the movable pulley doubles the power, and can be increased in any ratio by adding to the number of pulleys In a combination of pulleys, the advantage, however, is greatly diminished by the friction of the axles and of the ropes Too complex a combination, therefore, would not be of service, as the friction would be increased without a proportional advantage, and from the complexity of the machine would be more liable to be put out of order

Blocks used for gyns are of the Bothway pattern, double and triple blocks for ordinary weights For the heaviest guns two triple blocks are preferable, and a power of six is gained (*Vide* Tackle)

Pultun—An Indian term for a regiment of infantry

Pump, Forcing — As described in Weale's series, is an engine for raising water above the level to which it is driven by the pressure of the atmosphere The forcing pump consists of a barrel fitted with a solid piston or forcer, the barrel being also provided with a branch forcing pipe The lower part of the barrel and the branch pipe are each fitted with a valve opening upwards, and by repeated strokes of the piston, the pressure

of the air from above being removed, the fluid is brought up to fill the space between the two valves, and being prevented from returning by the lower valve, it passes through the upper valve of the branch pipe into a capacious upper vessel, and there accumulating, may be ejected in a constant instead of an intermittent stream

Punch—A tool for making an impression, or for forcing a hole through a plate

Punches, Steel Vent — Used for clearing the vents of guns They are of different lengths, according to the nature of the gun

Punching—A term used in Artillery The penetration of a vessel's side by an elongated shot or shell, which is intended to kill the crew, blow up the magazine, damage machinery, and sink the vessel by holes made at or near the water-line

Punching Machine — A machine for punching holes through thick metal plates For a description of the machine and its use,—*Vide* Weale's Dictionary

Purchase—The system pursued in the British army whereby promotion is obtained amongst the several ranks by the sale of an officer's commission A Bill has lately been before Parliament for the abolition of purchase with the view of putting the regular army and the militia on the same footing, and instituting a system of promotion throughout the service by seniority and selection The Bill passed the House of Commons, but was rejected by the House of Lords Subsequently Her Majesty, in the exercise of her prerogative, gave her sanction to he abolition of purchase, which obtains rom the 1st of November 1871 Promotion by purchase has existed in all egiments, except in the Artillery and Engineers, for the last 170 years,—death-steps only being obtained without purchase It is to be feared, however, that, unless the pay of the army is increased, and a sufficient inducement held out for early retirement, in the shape of a good retiring pension, stagnation in promotion, &c, must ensue, such as is now occurring in the non-purchase corps

Purchase—A mechanical term, signifying to gain or have an advantage over something by mechanical means in raising it, thus, to place a lever or handspike under any weight prepara tory to heaving it is a "purchase"

Pyroligneous Acid — One of the products of the destructive distillation of wood

Pyrometer—An instrument for estimating heat at a high temperature, such as that which the more infusible metals melt, or of a reverberatory or wind furnace for which the common thermometer is unavailable

Pyrotechny — This term denotes, in its widest sense, the art of controlling and making use of combustible matter, particularly in the manufacture of fireworks

Q.

Quadrant — In gunnery, is an instrument, generally made of brass, for ascertaining or adjusting the elevation of ordnance, particularly mortars, which have no tangent scale The quadrant is graduated into degrees and parts of a degree, having a movable index, with a spirit-level and vernier attached to it When the instrument is used, the limb or bar of the quadrant is inserted into the bore of the piece, the index which is attached to the graduated arc is then fixed to the particular elevation required, and the piece elevated or depressed until the spirit-level is horizontal, which is shown by the air bubble running to

the centre Since the first edition of this work, another pattern quadrant to that hitherto in use has been introduced into the service It differs from the one generally known, in being altogether of a stronger form , the bar or limb has been reduced to 12 inches in length , the base is broader, and is fitted with a stop to prevent its slipping into the chamber The counterbalance weight is arranged so as to ensure the quadrant lying flat on the bottom of the bore of the piece

Quadrate — To ascertain if a piece of ordnance is properly placed on its carriage, and the wheels of equal height

Quaker—A sham gun made of wood

Qualitative — In chemistry, this term has reference to the properties of a body, and the kinds of matter of which it is composed, without reference to quantity

Quantitative — In chemical analysis, is the determination of quantity of every individual element in the substance to be analysed

Quarantine — The time during which a ship is not permitted to communicate with the shore, or to land her passengers or crew, if suspected of any infectious disease The term signifies forty days, during which period a ship was kept formerly in quarantine Of late years, in consequence of the rapidity of steam communication, and the means taken to prevent disease as much as possible from breaking out in a ship, the quarantine laws have been relaxed, and quarantine is rarely demanded in British ports Vessels in quarantine fly a yellow flag at the main , and, when released from this condition, are said to obtain *pratique*

Quarter—To "give quarter" is to spare the life of a vanquished enemy

Quarter-Master—An officer attached to each regiment of infantry and cavalry, also to a brigade of artillery, whose duty it is to look after the quarters and rations of the soldiers and the ammunition belonging to the regiment

Quarter-Master-General —The chief of a department of the army, to whom is confided all orders relating to the subject of marching, embarking, and disembarking, quartering, billeting, and cantoning of troops, encampment, &c

He should be an officer of great experience, judgment, and activity He should be well skilled in military drawing and sketching, and should make himself thoroughly acquainted with the geography of the country he resides in

Quarter-sights — A scale of ¼ degrees cut on the upper quarter of the base ring of certain smooth-bored guns and numbered as far as 3 degrees By bringing the division expressing the required degree of elevation and the notch on the *side* of the muzzle in direct line with the object, the gun will have the proper degree of elevation When the lowest notch on the base ring and that on the side of the muzzle are brought directly in line with the object, the gun is then laid point-blank , thus the gun may be point-blank with reference to the object, yet with several degrees of elevation or depression with regard to the ground, or plane of the horizon

Quarters—In military stations, are the apartments of an officer either in barracks or houses

Queen's Regulations—Are regulations and orders issued by Her Majesty (through the Commander-in-Chief), having for their object the regulation of the whole military system of the army, with reference to its in-

ternal economy and discipline Every officer is directed to supply himself with a copy, and to make himself perfectly acquainted with them

Quick-lime — Is produced by exposing chalk and other kinds of limestone or carbonates of lime to a red heat in a kiln, by this means the carbonic acid is thrown off, and lime more or less pure is the result In this state it is usually called *quick-lime*

Quick-match—*Vide* Match

Quicksilver — Another name for mercury, and so called from its resemblance in colour to silver It is a brilliant white metal, possessing the remarkable and peculiar property of being fluid at common temperatures It becomes solid at *minus* 40° Faht, in which state it is malleable, flattens readily under the hammer, and can even be struck into medals (*Vide* Mercury)

Quill Friction Tubes—Are made from goose-quills, and on the same principle as the copper friction tube, they are used in the naval service, as the latter nature of tube is objectionable, from the injury it might occasion to men between decks

Quilted Grape—The old pattern grape-shot, which consists of a round iron plate or bottom, having an iron pin in its centre, around which the small shot are piled, quilted with canvas and tied, so as to appear in form something like a bunch of grapes, the iron corrodes the quilting, which must then be renewed

Quinsey — A throat complaint, which is common to horses it is brought on by cold or chill The symptoms are difficulty in swallowing, cough, fever The horse should be bled and given a fever-ball, and either a blister ointment or embrocation should be applied

Quintal — An ancient term given to what is now our hundredweight

Quoin—A wedge of wood or iron laid under the breech of a gun or the muzzle of a mortar by which the piece is elevated or depressed The smaller natures of mortars are fitted with elevating screws

Quota — That part which each member of a society has to contribute or receive in making up or dividing a certain sum

R.

Rabbet or Rebate—A deep groove, or channel, cut longitudinally in a piece of timber to receive the edge of a plank, or the ends of a number of planks, which are to be securely fastened in it

Racers — Are circular rails of metal let into the ground on which the trucks of traversing platforms run

Rack and Pinion—This combination in machinery may be considered the connecting link between wheel work and the lever, and is the most simple machine of the kind for producing a continuous vertical motion with great power In this machine the axis of motion forms the fulcrum of a lever whose longer arm is called the *winch*, and describes a complete circle, the shorter arm forming the 8 leaves or teeth of the *pinion*, and there is always one of these employed in lifting by one of its teeth the *rack* to which the load or other resistance is applied (*Vide* Baker's Elements of Mechanism)

Racking—A term used in artillery The impact of heavy shot of large size at low velocities, and intended to shatter ship's armour, and, by repeated shakes, ultimately to knock the whole structure to pieces

Rack-lashing — Rope used in pontoon or boat bridges for securing

the balks to the pontoon *Rack-lashing* is also used for gun platforms, to secure the ribands, planks, and sleepers together It consists of a piece of 2-inch rope about 6 feet long, fastened to a picket about 15 inches in length, having a hole in its head to receive the rope

Radiation of Heat—A body hotter than surrounding objects will give off its heat in right lines in all directions, and a body colder than surrounding objects will receive heat from them in right lines in all directions The transference of heat in this manner is called *radiation* Heat radiated from bodies follows the same laws of reflection as light The rapidity with which bodies can radiate and absorb heat appears to depend mainly upon the nature of their surfaces Bright metallic surfaces have least and dark and rough surfaces the greatest, power, and may be said to be inversely semi-proportional to their reflecting powers

Radius—In geometry, the semi-diameter of a circle

Rafts—Are balks of timber lashed together to form a bridge for crossing a river or stream, when more perfect means are not at hand From their low degree of buoyancy, however, they are seldom made use of

Good rafts can be made with casks or barrels, and form a better bridge than balks of timber

Rag-stone—A slaty stone used for whetting or sharpening the edges of tools subsequently to their having been ground on revolving grind-stones It is imported from Norway, and gives a finer edge than the sandstone

Rag Wheel—A toothed wheel, cog wheel, rack and pinion

Raid—Sudden incursion into a district by marauders or savage tribes

Railways or Railroads—As described in Brande and Cox's Dictionary, are roads constructed of trucks of iron called *rails*, on which the wheels of carriages roll drawn by steam engines, and to which they are confined by ledges or *flanges* raised on the tires of the wheels As early as the middle of the 17th century, the power of moving heavy weights, such as coals from pits by means of parallel trucks of timber with a horse as the moving power, was resorted to, the wheels of the trucks or carts being confined upon the beams or rails of timber by flanges projecting from the inside of the tire of the wheels From this form of tramway, several modifications were introduced with the view of making the tramway more stable and more easy of draught, and iron rails were subsequently substituted for wood Within twenty years after the first introduction of tramways of iron, the form of rail, called the *edge rail*, was brought into use At first it was confined to the mining districts and collieries for the transport of the product of the mines to the places of shipment, but this nature of railway acquired vast importance, when passengers and goods came to be transported on it by locomotive engines, which took place on the Stockton and Darlington Railway in 1825, but more prominently between Liverpool and Manchester in the year 1830 Since that time, the construction of railways adapted for general traffic, at a speed which would have been formerly thought impossible, has been carried on to a great extent in nearly all parts of the world In the transport of troops and the material of an army, the railway has been found invaluable, enabling large bodies to move simultaneously, and in future wars the railway, as it has already,

will doubtless play a very prominent part There is the danger, however, in time of war, of its falling into the enemy's hands, as happened in the late Franco-Prussian war, so that under these circumstances it cannot be always relied on to transport an army to any particular point at the wished-for moment Moreover, railways are easily susceptible of being broken up for miles by the enemy, when all movement by such means is brought to a stand still This is undoubtedly realised by every general in command, who will be careful to have other means at hand for the transport of the material of his army, or the means of repairing a broken line

Rain Gauge—*Vide* Pluviometer

Raising a Siege—Abandoning the siege of a fortress

Raking—Enfilading or sweeping a work with artillery

Rally—To re-form disordered or dispersed troops.

Ram—A solid metal plunger or piston which fits tightly into the cylinder of an hydraulic press

Ram—A term used in thrusting home the charge into a piece of ordnance Hence to "ram home" a charge

Rammer Head—A circular block of wood attached to the sponge staff, which is slightly hollowed out to receive a female screw for the purpose of withdrawing the charge, if necessary, to prevent injuring the fuze, the holes in rammer heads have been enlarged The rammer head itself is used for ramming home the shot or shell into a gun or howitzer The form and size of rammer heads depend on the nature of gun with which they are used

There is also an instrument termed a rammer head, which is used in the examination of ordnance It is shaped to the form of the bottom of the bore, and furnished with a staff, for ascertaining the interior position of the vent A profile board, similarly shaped, and with a groove on the edge, to hold putty, may be used for the same purpose and to verify the curve at the bottom of the bore The position of the vent, or where it enters the bore, is ascertained by thrusting in a priming wire, and marking where it makes an impression on the wood

Ramp—A gentle incline, constructed along the interior slope of a rampart, to facilitate the passage of artillery, &c, from the interior to the terreplein of the work

Rampart—In fortification, the great mass of earth thrown up from the ditch inwards, in order to give the defenders a commanding surface for their cannon and musketry

Ramrod—An instrument either of wood or iron for ramming home the charge in muzzle-loading small-arms

Random Shot—A shot taken without any particular aim

Range—As defined in Brande and Cox's Dictionary, is the distance from the muzzle of a gun to the second intersection of the *trajectory* with the *line of sight*, (the first intersection is made near the muzzle, where the shot in its ascent crosses the line of sight) The *range* is not accurately the distance to the point at which the shot impinges on the plane, unless that is also the point aimed at, but the difference is practically of importance only at short distances In practice the *range* is usually measured from the muzzle of the gun to the point of impact on the object, or to the first graze of the projectile The range depends upon the *initial velocity*, the form and density of the projectile, the

angle of elevation of the gun, and the difference of level between the planes upon which the gun and object respectively stand

Rank—The relative position in the army which officers hold with respect to each other. Hence *regimental rank, local rank, army rank, &c* The term is also applied to a line of soldiers drawn up side by side

Rank and File—Men carrying the firelock and standing in the ranks are called *rank and file* Corporals are included in the return which is made under that head

Ransack—To pillage, to plunder

Ransom—Price paid for the release of a prisoner of war from captivity or punishment

Rapidity of Firing—The rate at which ordnance of all natures can be fired As remarked by Lt-Colonel Owen in his Modern Artillery, "When rapidity is combined with accuracy of fire, the effect is greatly increased, but the latter should not be sacrificed to the former, except at case-shot ranges , a too rapid fire is dangerous to the gunners, and wastes the ammunition As a general rule, the fire may be more rapid as the range decreases, the probability of hitting being less as the range increases In ordinary practice, rifled guns can be fired as quickly as smooth-bored guns, and muzzle-loading rifled guns as rapidly as breech-loading pieces With well-drilled gunners, about two rounds of shell can be fired from a rifled piece in a minute,* the gun being properly laid at each round , three or four rounds of case can be fired in the same time"

* Segment, with percussion fuzes, rather more quickly—about seven rounds in three minutes , but shrapnel, with time fuzes, only about five rounds in the same time

Rapier — Formerly signified a long, straight, broadsword, such as those worn by Scotch regiments , but is now understood to mean an old long pointed sword

Rappel — The French term for drums beating to arms

Rarefaction—The act of causing a substance to become less dense , it also denominates the state of this lessened density

Rasps—Are large rough files A rasp is formed when the surface of the steel is dotted over with separate teeth formed by the indentation of a pointed chisel or punch Rasps are used for woods and soft materials , double-cut files for metals and general purposes Rasps are in very general use with most artificers

Ratan (*Calamus*) — The plants which yield ratans are considered by botanists as a genus of the family of palms They are abundant in all the forests of the Malay and Philippine Archipelagos, and are used extensively as cordage or ligatures, or in the manufacture of mats and basket-work The best are the produce of Malacca A coarse description is found in many parts of the Peninsula of India, and these are used for ordinary purposes, as baskets, &c It answers better than bamboo for baskets, and for strong fences when interwoven between stakes The ratan, when burnt, yields an ordinary black for paint

Ratchet Wheel—As described in Baker's Elements of Mechanics, is a simple contrivance for preventing a wheel from turning except in one direction A catch plays into the teeth of the wheel, permitting it to revolve, but preventing any recoil on the part of the weight, or resistance contrary to the direction of the power This contrivance may be connected with other

machinery by means of teeth instead of cords, or the wheel and axle, as in the cases of the turn-stiles of bridges, &c , where the number of turns of the ratchet wheel is required to be registered

Rate-book — A table of prices containing the value of Government stores, and by which officers and soldiers are debited for the loss of Government property under their charge, if lost through carelessness, &c

Ratio—Is the mutual relation of two *magnitudes* of the same kind to one another, in respect of *quantity*, and is divided into arithmetical and geometrical ratio

Ration—A soldier's daily allowance of food, consisting in India of

1 lb of bread	⅐ oz of tea
1 lb of meat	1 oz of salt
4 oz of rice	1 lb vegetables
2⅓ oz of sugar	3 lbs firewood

In the field, when provisions are scarce, an officer can claim to be rationed

Rat-line—The rope or cord used for enclosing any spot or ground

Rat's-tail — A tapering file , also the tapering at the end of a rope

Ravelin—Is a work having two faces forming a salient angle, placed beyond the main ditch opposite to the curtain, and separated from the covered way by a ditch that runs into the main ditch

Raze—To demolish, to level with the ground

Re-agents—Are the substances employed by the analyst in ascertaining the nature of a body under examination , they are usually divided into *general* and *special* re-agents , the former designation is commonly applied to those substances which are used to separate bodies into different groups , and the latter, to those employed to distinguish the members of these groups from each other The reader is referred to Abel and Bloxom's Hand-book of Chemistry for further information on the subject

Realgar—(*Vide* Orpiment)

Ream—To scoop out , to enlarge or widen the bore of a piece of ordnance to the required calibre The practice of *reaming-out* guns, or *boring them up*, first took place in the British Service in 1830, and it was done with the view of increasing the weight of metal projected from such guns as were then on hand in the British Service, at a time when the advantages of large-calibred ordnance were not absolutely decided on It was therefore but a temporary expedient, and their use now may be said to be abandoned Means are now taken to utilise our old heavy smooth-bored guns by relining them on the Palliser system

Rear Chock Carriage — Is similar to the common ship carriage in construction, except that a block of wood is substituted for the rear axletree and trucks , it is run up by means of a roller handspike

Rear Guard — A detachment of troops which brings up and protects the rear of an army It is composed generally of all arms

Rebate Plane—A surfacing plane, having the cutting edge of the iron extending the full width of the sole of the plane

Receivers — Various forms of vessels employed to collect the products of any distillation Those used in the laboratory generally consist of glass globes of sizes, provided with one or more necks

Reciprocal—In mathematics, is that number which, when used as a multiplier to the number, gives 1 as the result. For instance, the reciprocal of 7 is ⅐ or ·1428571, and *vice versâ*

Reciprocating Motion—The movement of a body backwards and forwards Reciprocating motion is frequently required in some kinds of machinery, and the application of this motion is best observed by a crown-wheel, double rack, and eccentric wheel

Recoil—In artillery, the motion of a piece of ordnance or small-arm in a direction opposite to that of the shot when the piece is fired It is caused from the ignition of the charge impelling the gun and shot in opposite directions This action of recoil has a very destructive effect upon the carriage of a gun With heavy guns, the effect of recoil is considerably reduced by the use of hydraulic or pneumatic buffers *Vide* Buffers

Recoil has no effect upon either the velocity or the range of a projectile in big guns (smooth-bore) The shot, it is believed, has left the piece before the gun commences to recoil With small-arms, there is a perceptible difference in the range, whether the gun be fired from the shoulder or from a fixed rest

Reconnoissance—An examination of a portion of country with a view to ascertaining its resources for the movements and subsistence of troops The following is extracted from Lieut E S W Campbell's Dictionary of Military Science on the subject of reconnoitring —

" The intention of reconnoitring is to supply the defects of maps, and to acquire a familiar knowledge of a country which is to become the theatre of a campaign

" Distinguish the particular parts of the map by certain marks of reference, and after the reconnoissance is made, draw up a memoir under the following heads, accompanied by sketches, and referring to the marks on the map, state particularly whether your information is derived from personal examination, or from the authority of others, mention the authority, and remember that, in military maps, nothing should be represented at guess or random —

"ROADS

" *I—Examine and describe the Roads, mile by mile, and report—*

" 1 —Their breadth

" 2 —Their quality, whether gravelly, rocky, sandy, loamy, or marshy Whether affected by rainy weather, and whether repairable, and by what means

" 3 —Are they level or hilly, with gradual, abrupt, or rocky ascents, having short turns or other difficulties, and whether bounded by walls or hedges

" 4 —Are they fit for cavalry, infantry, or artillery, or all of these, if not, can they be rendered so by pioneers

" 5 —Whether bad parts of the road, or narrow and embarrassed streets, if any, of the towns or villages through which it passes, can be avoided by quitting it for a short distance, and what work is necessary for this purpose

" 6 —The names of the towns, villages, and single houses along the road, their distance in English miles, and also in the measures of the country

" 7 —The bridges, the ferries, fords, streams, and rivulets crossing the road, the best means of obviating these obstacles, by bridges, wading, &c The possibility of breaking up the road, destroying the bridges and fords, the means of effecting these objects and the time requisite

" 8 —The cross and bye-roads, the distance to the towns, villages, and private houses they lead to

" *II—Reconnoitre the banks of large Rivers, mile by mile, and report on them, as well as on Streams and Canals*

" 1 —Their sources, and the direction

of their course Whether navigable, to what extent, and by what description of vessels

"2 —Their breadth, depth, and the variations to which they are subject at certain seasons, and the nature of their channel

"3 —The nature of their banks, whether firm and practicable for cavalry and artillery to enter the water, or can be made so , steep, craggy, or marshy

"4 —The number of fords, their quality, capacity, and susceptibility of improvement , the nature of the ground within cannon-shot of each bank , and try whether there are not some other fords not generally known

"5 —The bridges, whether stone or wood , their length and breadth , whether accessible to artillery and capable of sustaining its weight

"6 —The ferries , their length, nature, and landing-place on each side The size of the ferry-boat, the number it contains, and the time occupied at each crossing

"7 —Canals, their course and breadth, the nature of the traffic carried on by them , the number of boats to be found at different places, and their capacity Remember that in describing a river, the right or left bank should be mentioned, and that these points are determined by the course of the river, your back being turned to its source

"*III —General Features Sketches of this description may be made on a scale of two inches to a mile*

"1 —Mills , whether water or windmills , how much grain can they grind during a day , can they be rendered military posts, or their streams turned to any other purpose

"2 —Plains, commons, &c Their breadth, whether firm or marshy, whether sufficient for the array of an army, whether crossed by rivulets, and if so, their width and depth

"3.—Whether the country is barren or cultivated, if so, their produce, whether open or enclosed, the description of the enclosures, whether hedges, stone walls, ditches, or fences , or whether they are fit for pasturage only

"4 —Woods should be carefully reconnoitred What roads pass through them, where they enter and where they issue The nature of the wood, whether thick or open, what species of trees, and whether there is much underwood Whether there are any houses in it, and what distance from the nearest village , its extent, and can it be advantageously lined against an advancing enemy

"5 —Marshes, morasses, or bogs, their situation and extent, whether passable for troops in any part

"*IV —Mountains, Passes, and Positions Sketches of these should not be on a smaller scale than one inch to a mile*

"1 —What parts of the country are mountainous, hilly, undulating, or level

"2 —Are the hills steep and broken by rocks, or is their ascent gradual

"3 —Note all strong passes, posts, or more extensive positions , their situation, extent, nature of soil, supply of water and of wood for firing and hutting

"4 —The nature of the valleys and ravines , their breadth, and whether easy or difficult of passage, the height of their banks, whence they arise, and where they debouche Note also if they bear the appearance of being filled by winter torrents, and to what depth

"***V —The size of the Towns, Villages, Forts, and Redoubts***

"1 —The dimensions of any fort or redoubt, the number of troops and

artillery, its situation, whether it is not commanded, and whether there is not some good approach to it, with a map or a sketch

"2 —The size of any town or village, the number of houses and inhabitants, and whether well supplied with provisions The description of houses, and the number of troops which can be accommodated, what stabling or other cover for horses

"3 —The situation of towns, villages, convents, farms, or other detached buildings, and whether they can be strengthened, and by what means, how are they supplied with water

"4 —The number of carriages, horses, mules, and draught oxen in each farm or village

5 —Whether the place is healthy or unhealthy at particular seasons, and state the cause"

Recruits—Men raised for service in the army to fill vacancies in regiments or to augment the strength of the army A recruit remains so, from the date of his enlistment until he has passed his drill Formerly recruits received what is termed a bounty on enlistment, but this has been done away with, and considering the inducement held out to men now-a-days to take to a military life as a profession, in the increased comforts and good-conduct pay given to the soldier, no bounty should be necessary It is not improbable that, before long, a new Enlistment Act will be passed having for its object the enlistment of men for shorter periods of service than at present, with the ultimate view of short-service men being drafted into the proposed reserve force

Rectification — In chemistry, the process of drawing any thing off by distillation, in order to obtain it in a state of greater purity

Rectilinear — Consisting of right lines

Red-sear Iron—Defect in iron which causes it to become brittle when heated, and to break when forged

Red-short Iron—One of the three principal varieties of malleable iron, possessing this defect, that it is brittle when hot, but extremely soft and ductile whilst cold

Redan — Is the simplest kind of trace for field works, having two faces, forming a salient angle, it serves to cover a bridge, causeway, avenue, &c, and being quite open at the gorge, is only suited for defence when resting its extremities on a river or obstacle which prevents its being turned, or else, when within the full sweeping fire of works in its rear, that an enemy may be deterred from any attempt to assault by the gorge

Redoubt — Is a field work enclosed on all sides, without flanks, and of a *square, polygonal, circular*, or *irregular* figure, the circular form is rarely used, from the unsuitable nature of such an outline to ground in general, and the total impossibility of giving any flanking defence to its ditch The sides of a square redoubt should not be less than 24 yards, or in general more than 42 yards

Reduit—A keep, capable of defence after the enemy has penetrated into the outer works of a field fortification or military post, it greatly tends to the security of any work It should have a command of 5 feet, so that it should not be seen into by the enemy Block-houses form the most suitable reduits for field works

Re-entering Angle—In fortification, is an angle pointing inwards or towards the place

Re-entering Places of Arms—As described in Straith's Fortification, are enlargements in the covered way, at the re-entering angles of the counterscarp, this space is formed by setting off demi-gorges of thirty yards (more or less), and making the spaces form angles of 100° with the adjoining branches of the covered way

Reeve—To pass a rope or tackle through a block

Refining—Is the purification of any metal or salts, such as nitre undergoes before it is fit for gunpowder purposes For the process observed, *Vide* Nitre

Refraction of Saltpetre—In commerce, is the ascertaining, with accuracy, the quantity of the pure salt, or which answers as well, the amount of impurities, contained in a given sample Government, for gunpowder purposes, generally purchases saltpetre at 5 per cent refraction

Regiment — The derivation of the word "regiment" seems to come from the Latin *regere*, to rule or govern Hence a regiment is said to be governed or commanded by a Colonel A regiment consists of a body of soldiers enrolled together, consisting of one or more battalions of infantry, or several squadrons of cavalry As stated by James, regiments were first formed in England in 1660 The regiment of artillery is composed of brigades, the term brigade being synonymous with that of regiment, and is commanded by a Colonel

Regulation—As applied to an officer's commission, is the regulated price paid by him for each step of rank, and which is refunded on his retiring from the service A fixed sum is laid down as the price of each commission, but this is constantly exceeded, and though unlawful, has been tacitly recognised by the authorities, and in the bill before Parliament for the abolition of purchase, it is intended to recompense officers for the sums they have over-paid

Regulators — As described by Lardner, are that class of contrivances which have for their object to render the power and resistance proportionate to each other They generally act upon that point of the machine which commands the supply of the power by means of some mechanical contrivances, which check the quantity of the moving principle conveyed to the machine whenever the motion becomes accelerated, and increase the supply whenever it becomes retarded For example, this is accomplished in a steam-engine by acting on a valve called the throttle valve, placed in the main pipe, through which steam flows from the boiler to the cylinder

Reinforce—Is that part of a gun where an increase of metal is given to enable it to withstand the explosion of the charge There are two reinforces in the ordinary smooth-bored cannon, the first reinforce extending from the rear of the base ring to that of the first reinforce ring a little in rear of the trunnions, second reinforce, from the rear of the first to that of the second in front of the trunnions It is in the first reinforce where the greatest thickness of metal is found Since the introduction of coiled guns, the term reinforce is in disuse in describing guns of this nature

Rejoinder—In military courts-martial the prisoner is entitled to a rejoinder, that is, when the prosecutor makes a reply to the defendant, the latter may answer again, and he may even call witnesses to re-establish the character for credulity of such of his

witnesses, as may have been impugned by the prosecutor's evidence in reply

Release—As applied to soldiers undergoing imprisonment, is the prerogative a commanding officer has of releasing a prisoner from confinement This power is vested in him alone He has further the power of remitting the sentence of a regimental court martial, convened by himself, and directing the release of the prisoner should he not approve of the sentence or finding

Relief—In fortification, the general height to which the works are raised, if the works be generally high and commanding, they are said to have a bold relief, if the reverse, a low relief

Remblai—In fortification, the quantity of earth or soil contained in the mass of the rampart and parapet of a work In general, the number of cubic yards contained in the "remblai" has been furnished by the "deblai," so as to balance each other

Remonstrate—In military life, to remonstrate is permitted if an officer or soldier considers himself aggrieved on any point, but it must be done in a respectful manner through his commanding officer to higher authority, at the same time, where the duty of the service may require it, that duty must be first carried out with cheerfulness and alacrity

Remounts—The name given to horses which are passed out of the stud for artillery or cavalry purposes The general age of remounts is about five years old

Rendezvous—A military term, expressing any appointed place of assembly or meeting

Report—A specific statement on any particular subject, or persons, which superior authority may desire to possess, and which it is in the power of the person applied to, to afford

The word is also used to express a loud noise, such as that made by the discharge of a cannon or musket. The distance to which cannon can be heard depends on the wind and the state of the atmosphere, also whether conveyed over water, which increases considerably the distance to which sound can reach During the Sutlej campaign, in 1845-46, the report of the guns at the battle of Sobraon was distinctly heard at Loodianah, a distance of 80 miles Loodianah is situated on the river Sutlej

Repository—A museum or place of deposit of musters or samples of the different arms, tools, stores, &c, used in the Service The repository forms a school of instruction for officers and men on first joining the artillery

Reprisal—As expressed in Brande and Cox's Dictionary, is the capture of property belonging to the subjects of a foreign power, in satisfaction of losses sustained by a citizen of the capturing state Letters of reprisal are grantable by the law of nations, where the subjects of one state have been oppressed or injured by the subjects of another, and where justice has been refused on application by letters of request The power of granting letters of marque and reprisal has been given by statute, and sometimes by proclamation, to the Lords of the Admiralty

Requests, Courts of—Are local courts for the recovery of small demands not exceeding 400 rupees In the several military cantonments of India, a Court of Request is assembled monthly, and all persons are amenable to it but soldiers Not less than three officers, all military men, should form the Court

Reserve—A select body of troops retained in the rear of an army for any particular object, generally to support an attacking force

Residuum—A term used to express what is left after the principal agent of any substance or body has been extracted for instance, the impurities left after saltpetre has been thoroughly extracted from the crude substance

Resistance of the Air — With reference to the trials made with Navez-Leurs' electro-ballistic machine, it appears from the calculation of Captain W H Noble, R A , that—

1 The resistance to the air is practically proportional to the square of the diameter of the projectile

2 Within the limit of 1,200 and 1,500 feet, the resistance appears to vary nearly as the velocity cubed

3 When the velocity of the projectile passes below 1,100 feet, there appears to be a gradual, but at the same time rapid, reduction in the amount of resistance as if the projectile were being rapidly relieved from some extra pressure This rapid diminution ceases when the projectile reaches about 1,000 feet

4 Within the limit of 1,000 feet and 600 feet, the resistance appears to vary nearly as the curve of the velocity

Captain Noble says, in his 5th paragraph on the same subject, that it is difficult to account for the rapid diminution of resistance between 1,100 and 1,000 feet

But the difficulty appears subsequently to have been solved by Professor Haughton as follows "The air cannot follow a projectile at a higher velocity than that of sound , that, as long as the projectile travels slower than sound, the air closes in completely behind it by molecular propagation of impulse , but the moment that velocity exceeds that of molecular propagation (or sound), that moment there exists imperfect vacuum behind the shot" "This," Captain Noble says, "would account for the rapid reduction in the resistance alluded to"

Rest—In a lathe, a piece of iron to hold the turning tool upon, fixed at the end of a slide by a set-screw , the slide can be moved at right angles to the bar of the lathe, and the whole can be fixed at any part of the bed between the centres

Retardation — The resistance offered to any body in motion by the medium through which it moves Thus a shot is retarded in its flight by the resistance of the air *Vide* Medium

Retired Flank — A flank bent inwards towards the rear of the work, or army, of which it forms a part

Retort—A vessel of glass, earthenware, porcelain, clay, iron, &c , in which some kind of distillation is carried on A chemical retort is generally made of glass having a *receiver* annexed to it for the purpose of collecting the products of distillation

Retreat — Beat of the infantry drums or sound of the trumpets of the cavalry in camp or garrison, which takes place every day at sun-set, after which no trumpets are to sound or drums to beat, except at tattoo, or in case of fire or other alarm

Retrenchment — In fortification, is an inner defensible line to cut off a trench or other weak point , so that the capture of the latter shall not involve that of the retrenched post

Returns—In a military sense, are documents which are required periodically or otherwise from every regiment and department of the army, and which embody in their respective branches all the information required by higher authority

Reveille—Beat of drum or bugle sound at day-break, after which the sentries cease to challenge First drum beat or sound preparatory to a march.

Revenue Survey—In India, an important branch of the Surveyor-General's Department. Its operations consist in mapping districts, generally on the scale of 4 inches to the mile, and the maps serve a double purpose,—*viz*, in giving the boundaries of each village *holding*, for the guidance of the officer who settles the revenue to be paid to Government; and in giving also the topographical features, thus forming a valuable geographical map of the country under survey The mode of conducting a revenue survey is simple, and only requires a moderate knowledge of arithmetic and trigonometry, with the use of the instruments usually employed, such as the Theodolite, Plane Table, and Prismatic Compass The two latter may be said to be auxiliaries to the former, for the purposes of sketching and filling in the details of a map

The revenue survey is divided into several parties scattered over the country, under the charge of Deputy Superintendents of Survey, assisted by European, Eurasian, and Native subordinates

Reverberatory Furnace—*Vide* Furnace

Reverse Fire—In gunnery, when the shot strikes the interior slope of the parapet at an angle greater than 30°

Reverse Flank—In column, the reverse of the pivot flank

Revetment — In a permanent fortification, the masonry support afforded to the banks of earth on each side of the ditch, backed interiorly by buttresses The escarp and counterscarp are such revetments In field fortifications the materials used for the revetments, are gabions, fascines, sandbags, and occasionally sods, hurdles, casks, wood, planking, &c

Review—In a military sense, is the inspection of a body of troops, by the Sovereign or any other high personage, or by the General in command

Revolver—A many-barrelled pistol revolving round a central spindle By a certain mechanical arrangement the chambers of each barrel are brought successively under the action of the trigger, and when all the barrels are loaded, several shots can be fired without the necessity of reloading Among the many revolvers manufactured, those by Colt, Tranter, Deane, and Adams are best known

Ribands — Are scantlings of wood about 15 feet long and 4 inches square, used in rack-lashing gun platforms to keep the platform secure, they are also used for mortar platforms Two ribands accompany each platform

Ricochet—The bounding course of a projectile fired at a low angle in the field, not exceeding 3°, or in the ricochet of a fortification not exceeding 10° As explained by Lieut -Col Owen, ricochet fire consists in placing a battery at right angles to the line of troops or works aimed at, as in *enfilade*, but the shot having to clear a parapet which covers them, it is necessary to fire with a reduced charge and greater elevation, so as to give the shot a low* velocity and a high curve, in order that it may be brought down immediately after clearing the crest of the parapet, and then by rebounding along the face of the work, dismount the guns, or rake the line of troops under cover, as the case may be The ordnance best adapted for ricochet fire are the 8-inch shell guns of 52 or 50 cwt, but any rifled gun throwing an elongated projectile which is capable of holding a large bursting charge,

* But it is now generally acknowledged that it is far better to rely upon the explosion of a shell than on the bound of a shot moving slowly.

might also be used to drop shells into a battery so as to burst on grazing, the path, however, of an elongated projectile is so eccentric after grazing as to render it not so well adapted for ricochet fire as the balls of smoothbore pieces

Riding the Wooden Horse—As described by James, a punishment which was formerly much resorted to, not only in the British army, but in the armies of other nations A wooden horse, made of plank, was roughly nailed together, forming a sharp ridge to represent the back of the horse, it was then supported by posts to serve as the legs of the animal, about six or seven feet long, the whole being placed on a movable truck When a soldier or soldiers had to undergo punishment, they were placed on this horse, with their hands tied behind their back, and frequently muskets were tied to their legs, to prevent the horse, as was humorously observed from kicking off

Rifle—A musket or carbine, the barrel of which is provided with grooves for the purpose of giving a rotatory motion to the projectile In the British army, as well as in all the continental armies, a breech-loading rifle is now the general arm in use, but the introduction of it is of recent date The rifle formerly used, and then only in small numbers, in the British army, was the two grooved arm, a muzzle-loader During the American war in 1812, the Americans, in the contest with England, appear to have used rifles with a deadly effect from behind hedges and other cover, picking off large numbers of officers and men of the British force

Rifle, Enfield—The arm of the British service up to a very late date It has since been converted and made a breech-loader on the Snider principle, and has proved a very effective weapon The original pattern Enfield was introduced into the service in 1853, and the dimensions of this rifle are as follows —

Weight of rifle with bayonet, 9 lbs 12 oz

Length, 71 5 inches

Length of barrel, 39 inches

Diameter of bore, 577

Grooves 3, twist 1 turn in 6 ft 6 in

The dimensions of that introduced in 1860 are—

Weight with bayonet, 10 lbs 4 oz

Length of barrel, 33 inches

Grooves 5, other dimensions the same as the rifle of 1853

The small arm in use with the British artillery is an Enfield rifle carbine converted to a breech-loader on the Snider principle, and of the same sized bore as the Service Enfield, but having five grooves The increased number of grooves combined with increased twist is doubtless to the advantage of the piece in long ranges, though more liable to foul from its sharper pitch

Rifle Pits—Holes or short trenches capable of containing one man, and in the shape of an inverted frustum of a cone, with a seat in the rear, the top of the breastwork is made by placing two sand-bags across the parapet, and a third resting on these in the direction of it, to cover the head and shoulders of the rifleman A man should be able to complete a pit in one hour

The diameter of the top and bottom respectively is 4 feet 6 inches, and 2 feet 6 inches, while the depth is 4 feet

The French infantry, during the war with the Prussians, used rifle pits to a great extent, especially at the battle of Gravellotte, and they afforded considerable cover

Rifle Regiments—The regi-

ments so designated are the rifle brigade and the 60th regiment, which were originally armed with rifles, when the majority of regiments were armed with smooth-bored muskets, and though the whole army is now furnished with rifles, these regiments still retain their designation, and clothing (dark green)

Rifled Ordnance— Guns in which two or more spiral grooves are cut in the surface of the bore

The first rifled guns were introduced in 1846, when Major Cavalli and Baron Wahrendorff produced their breech-loading rifled guns In England, Armstrong's system of breech-loading (which was introduced in 1854 into the service) found many supporters, but it was not long before great doubts were entertained as to the reliance to be placed on his larger sized breech-loading ordnance, particularly in the Navy, and the same feeling against them prevailed more or less amongst artillerists It must however be remembered that the powder used with these guns (R L G) was identically the same, and of the same destructive nature as that subsequently used with the heavy M L rifled guns, which was considered too severe a powder to use in charges above 50lbs As far however as the strength of a gun is concerned, it appears that, to weaken that part which requires the greatest strength, such as the breech, by the admission of what may be termed a false breech, is to introduce an element of weakness in great guns where large charges are used

This brought about a feeling decidedly hostile to heavy breech-loading ordnance, and since then it has been the object of the British Government to provide itself with a muzzle-loading rifled gun which should answer all the requirements of the service, both military and naval, and such a gun the Government and Artillerists believe has been realized, in what is termed the "Woolwich gun," the grooving of which is a modification of the French gun, but in nothing else resembles it

This gun is built up of wrought-iron coils, and large numbers after this system have been manufactured at Woolwich, of different calibres, from the 7″ to the 12″

The success attending the manufacture of these guns is everything that could be desired The trials made prove the 9″ gun to be the strongest and the most penetrating gun that has yet been manufactured, having as well the longest range of any similar gun, and it will doubtless prove, in the hour of need, all that is expected of it On the same principle are made the heaviest rifled guns now in the service, among which has lately been added a 35-ton muzzle-loading rifled gun, the heaviest gun yet made The satisfactory completion of this gun will realize to the outside world the capacity of the Woolwich Gun manufacturing establishment

The advantage of rifling appears to date back to the middle of the last century, as was explained by Robins in a tract in 1747 (though the grooved barrel is said to have been introduced in 1498 by Gaspard Zuller, of Vienna), who not only remarked on the value of grooving, but suggested the shape a projectile should be, *viz*, elongated, and gave as his opinion that whatever State should thoroughly comprehend the nature and advantages of rifled barrel pieces would acquire a superiority to the advantage of the State using them

The object of rifling a gun is,—

1*st* —To give the projectile a rotation round an axis coincident with that of the bore, whereby increased accuracy of fire is obtained

2nd—In substituting elongated for spherical projectiles, to obtain increased range

To insure accuracy of fire, sufficient velocity of rotation must be given to the projectile, otherwise it will have a tendency from the pressure of the air to turn over, or to be unsteady To give the high velocity required, especially from heavy guns, the gun must be able to stand a large charge, and this until very lately has been the artilleryman's difficulty, as, beyond a certain point, no increased thickness of iron adds to the strength of the gun

Fortunately the War Office assembled a "Committee on Explosives," to test the strength of powders, of foreign and home manufacture, with the view of selecting a powder or of making a powder, which would exert less pressure on the gun than the present service powder Accordingly, specimens of R L G powder, Russian and English prismatic powders, and a sample of what is called "pebble powder" made especially for the occasion, were brought before the committee, and the velocity of the shot impelled by these powders was tested in an 8-inch gun by means of Captain A Noble's newly invented chronoscope, which is able to discover the rate at which a projectile leaves the piece, to the millionth part of a second The pressure on the gun was found by Rodman's pressure gauge, or rather by a pressure gauge made for the Committee The gun was perforated with holes along the length of the bore at different distances, which were then plugged and brought into communication with an electric battery by means of three copper wires running through the plugs The result of this scientific investigation was as follows —

Nature of Powder	Charge	Muzzle Velocity	Maximum Pressure
	lb	Feet	Tons
R L G	30	1,324	29 8
Russian Prismatic	32	1 366	20 5
Service Pellet	30	1,338	17 4
Pebble	36	1,374	15 4

From the foregoing it will be observed, that while the pressure with R L G powder with a 30 lb charge was upwards of 29 tons on the square inch, the pebble powder with a slightly increased charge only showed a pressure of 15 4, and gave an increased initial velocity

For the various detailed systems of rifling in our own and continental artilleries, *Vide* Lt-Colonel Owen's Modern Artillery, and Brande and Cox's Dictionary

Rig—In military parlance, to fit up—an expression made use of in fitting up a gyn or capstan for working, &c

Right Angle—In geometry, is that formed by a line falling perpendicularly on another, or that which subtends an arc of 90°

Right Ascension — Of a heavenly body, is the arc of the celestial equator intercepted between the first point of Aries and the circle of declination passing through the body The right ascension is always measured from west to east, entirely round the circle

Rimer—A steel tool of four, five, or eight sides, for drilling holes in iron work A conical bit of the shape of the fuze hole of a shell, used formerly for giving the shell the proper dimensions and finishing off

Ring Bone—A bony deposit in one of the pasterns of a horse's foot. It is principally confined to draught horses which have to drag heavy weights up steep ascents The entire force is then thrown upon the bones of the pastern, inflammation ensues,

lymph is effused, the lymph becomes cartilage, and the cartilage is converted into bone Then an exostasis is established and a ring bone is the consequence Remedy—apply poultices on which one drachm of powdered opium and one of camphor has been sprinkled Rub the disease with equal parts of oil of camphor and of chloroform Then, after the pain has ceased, apply the following ointment night and morning —

Iodide of lead, one ounce
Lard, eight ounces —(*Mayhew*)

Ring, Breech Tangent Sight, Armstrong Gun—This ring is of gun metal and fitted to a narrow seat on the breech end of the gun, and is secured in position by a steel tightening screw, with a conical end corresponding with a hole in the left side of the gun, which receives it When this ring is removed, great care should be taken, whilst replacing it, to adjust it exactly in its proper position, as the slightest deviation from it will affect the accurate sighting of the gun The 40-Pr (old pattern), 20-Pr , 12-Pr , and 6-Pr are the only guns fitted with a breech tangent sight-ring In the 40-Pr (new pattern) and 9-Pr guns, these rings are dispensed with, and the sights are fitted into a gun-metal socket, let into the side of the gun itself

Rivets—Short bolts of metal inserted in a hole at the juncture of two plates, and after insertion hammered abroad at the ends so as to keep the plates together Mr William Fairbairn has invented a rivetting machine which by the aid of steam performs the work rapidly and without noise

Rivetting Machine—By this machine, the invention of Mr Fairbairn, the work of rivetting metal plates together is done by an almost instantaneous pressure, and without any noise The boiler or any other work is suspended between a die on the upright post, when a moving slide and die worked by the action of a revolving cam upon an elbow joint closes the work and finishes the rivet

Rockets—The following general description and principle of a rocket is taken from Lieut -Col Owen's Lectures on Artillery —

" A rocket consists of a cylindrical case of paper or metal containing an inflammable composition, to the end of the case is attached a head usually of a conical or cylindro-conical form, and the other end is closed, but has one or more vents or holes in it, for the escape of the gas, from the ignite decomposition

" The composition is driven into the case over a conical spindle, passing to a certain distance up the centre, thus leaving a hollow space in the interior of the rocket, the base of the hollow cone coinciding with that of the rocket

" The object of having this cavity in the interior of the rocket is, that a large surface of composition may be at once ignited when the rocket is fired, and so great a quantity of gas generated within the case that it cannot escape from the vent as quickly as formed, and therefore it exerts a pressure in every direction on the interior surface of the rocket The pressures on the sides of the rocket mutually balance each other, but the pressure on the head is greater than that on the base, in consequence of the escape of gas from the vent or vents , it is this excess of pressure on the head over that on the base which causes the rocket to move forwards, this being merely a similar action to the recoil of a gun fired "

A stick or long rod is attached to the base or side of the rocket in order to counteract, by the resistance of the air upon it, any tendency to turn over,

and to maintain the rocket during its flight as nearly as possible in the direction in which it is fired, when accuracy is required, the stick should be strictly in prolongation of the axis of the rocket.

Rockets, Congreve — These rockets (which are no longer in use) were, up to a late date, known as the War Rockets of the British Service They are so called from the improvements introduced by the late Sir W Congreve, in the manufacture of the common rocket, by which it could be adapted to war purposes The case consists of sheet-iron A hollow iron head, cylindro-conoidal in form, is screwed on to one end of the case, which can be filled with powder when intended to act as a shell, but left empty if only intended for a shot Each Congreve rocket is fitted with a fuse fixed in the base of the shell, which, in setting the rocket for any particular distance, is bored into, through a hole in the apex of the shell The object of this hole is not only for the purpose above described, but to admit of the bursting charge being placed in the shell it is closed by a metal screw plug

The bottom of the case is closed by an iron disk or plate, having a centre hole into which the stick is screwed, and five other holes or vents (for the escape of the gas) equi-distant from each other and from the centre hole

The value of the Congreve rocket in a tropical climate was always questionable, the composition, from long storage, shrinking from the sides of the case, and the case itself contracting, thus rendering the rocket liable to burst on being ignited Rockets to be of use therefore in such a climate should be made up when wanted, and not allowed to remain an indefinite time in store

Rockets are either fired from tubes supported on stands or in volleys from the ground A stand is not absolutely necessary for the smaller natures of rockets, except when fired at high angles

Rockets, Hale's — Were introduced into the British Service in 1867, and have superseded the Congreve rocket They are the invention of Mr Hale The case is similar to that of the Congreve rocket, except the base, which is in the form of a frustrum of a cone, having a large vent hole through its axis, and five small holes cut through its exterior surface into the rocket in an oblique direction termed "tangential holes" The object of these holes is to give the rocket, by the escape of the gas through them, a rotatory motion on its longer axis, in consequence of which it will proceed forwards in its flight, point foremost, as in the case of an elongated projectile fired from a rifled cannon, the stick can therefore be dispensed with, and the body of the flame allowed to escape through the large vent in the centre of the base In firing these rockets, they are not allowed to leave the tube until they have acquired sufficient velocity to overcome the pressure of a small spring within it, they are thus prevented from "drooping," to which they would be liable if allowed to leave the tube with a very low velocity A rotatory motion is also imparted by the tube, which is made of iron hoops twisted into a spiral form Since the first edition of this work, Hales' 9-pounder rockets, made at the Woolwich Arsenal upon a modified plan, were tested in February 1869

Formerly the cases were made of drawn tubing, which was liable to split. But they are now formed of *Atlas Metal* rivetted and brazed, and

having three corrugations to prevent the composition from giving way during flight A V-shaped trough was tried, as well as the ordinary tube for directing the discharge, the trough presenting decided advantages, and permitting the use of the ordinary service friction tubes The trial showed that 10 degrees of elevation are as much as are practically useful, the composition having ceased to burn just before the rocket came to earth, with the range thus obtained

Rockets of heavier natures were also tried with a V-shaped trough, and answered well There are two natures of Hale's rocket in the service the 9-Pr and 24-Pr,—the former for all services except garrison and naval, the latter for service in fortresses

Rockets, Signal—As their name implies, are used as signals between distant camps, forts, &c, and are most valuable on account of the distance they can be seen on a clear night, ascending to heights varying from 450 to 1,200 yards, according to their diameter It has been ascertained that they can be seen within a circuit of from 35 to 40 miles

The case of the rocket is made of thick brown paper, and is capped with a cone-like head, in the former is the composition, in the latter the composition for the stars Rockets are fired from stands, and in a perpendicular position They are generally of two sizes,—*viz*, 1 lb and ½ lb rockets

Rodman's Pressure Gauge—Is the invention of an American officer for determining, as described by Lt-Col Owen, the absolute pressure of the gas in the bore of a gun, the metal of which is perforated at different distances Into each hole a *pressure gauge* is screwed, consisting of a piston, an indenting tool, and a disc of copper, when the piece is fired, the piston, one end of which projects as far as the bore, being exposed to the pressure of the gas, is forced outwards, and presses the tool—having a broad but thin point—into the copper disc, the indentation made being compared with that obtained in a testing machine with the same tool, and a piece of copper cut off the same bar

An improvement upon this gauge has been made for the use of the Committee on Explosives called a *crusher*, the pressure of the gas being ascertained by the compression of a copper cylinder upon an anvil by the piston

Rods, Cleaning—Used formerly for cleaning the 40-Pr Armstrong guns They are plain wooden staves with projecting iron pins at one end, tow is wrapped round the pins when the rod is brought into use

Roll-call—In military life, it is necessary for the sake of discipline and to prevent soldiers from wandering about indiscriminately at all hours, as well as for the purpose of having them available at any moment in case their services are required, that the men of a regiment, company, or detachment should be present to answer their names during certain fixed periods of the day, or at any time the commanding officer may think advisable This is termed *roll-call*

Roll of a Drum—A continuous and uniform beat of the drum for a certain time What is known as the *long-roll*, is a beat by which troops are assembled at any particular spot of rendezvous or parade

Rollers—Are solid cylinders of wood, used in mounting guns upon their carriages, or shifting them from carriage to carriage, and in moving them on the ground Their dimensions

vary, according to the nature of the service for which they are intended The name is also given to massive rollers of iron, weighing about 4½ tons, having faces 18″ broad, which are used in the incorporation of gunpowder They are termed *edge rollers* or *runners* *Vide* Runners

Romans—The following quaint custom, extracted from James's Dictionary, may not be without interest —"Before the establishment of the mess at the Horse Guards, which was formerly paid out of the king's privy purse, and subsequently charged in the extraordinaries of the army, the captain of the guard at St James's kept a table for the subalterns attached to that duty In order to enable the captains to support these expenses, a certain number of men were allowed to work in the metropolis, on condition that they left their pay in the hands of their officers, these men were called *Romans*"

Rope—The term is usually applied to all cordage above 1 inch in circumference made of hemp, spun into yarns or threads, of a certain length, a number of yarns or threads, according to the size of the rope, are twisted together into a strand Three of these strands twisted or laid together are called a *hawser-laid* rope, and nine of them a *cable-laid* rope When the rope is made very thick, it is called a *cable*, and when very small, a *cord*" The following is also another definition of rope "A rope consists of three strands, a strand of a certain number of yarns, and yarns are made of the hempen fibres The number of the fibres making a yarn is not counted, but the yarn is estimated by the weight of the hemp in a given length Fibres are *spun* into yarn yarns are *registered* into strands, and strands are *laid* into rope Rope-making dates from the earliest times Various kinds of fibre have been used for the purpose, such as hemp and flax, tough grass, the husk of the cocoanut, the fibres of the wild banana, &c, and animal substances have been used, such as strips of an ox hide, horse hair, and wool Ropes have also been made of metallic wire The size of a rope is designated by the circumference or girth thus a 3-inch rope measures 3 inches The length is usually expressed in fathoms"

The strength of ropes is sometimes calculated by the following rule "Multiply the circumference of the rope in inches by itself, and the fifth part of the product will express the number of tons the rope will carry, in practice, a rope should not be subjected to more than half this strain It stretches from 1-7th to 1-5th, and its diameter is diminished from 1-7th to 1-4th, before breaking White rope is stronger than tarred rope, and only ropes that are to be immersed in water should be tarred The strength of Manilla rope is less than that of hemp rope The good quality of rope is sometimes discernible by its color, which borders on silver grey, though this is not always a sure sign, a better test is its smell Cordage of a strong odour should have the preference, and such as smells rotten, mouldy, or exhales heat, should be rejected To store ropes, they should be placed in the upper storeys of a building, coiled up and labelled, large ropes on skids, so as to allow the circulation of air, small ropes being hung up Ropes should be uncoiled every year, and stretched out for several days at the beginning of the dry season Rope is issued in coils of 120 fathoms each Marline and Hambro line in skeins, and spun yarn in pounds"

Rose-Engine—A peculiar kind of turning lathe having special chucks for the production of those patterns of curved lines called by the French *rosettes*, from the slight resemblance which they bear to a full-blown rose, and hence the term *rose-engine* The rose-engine lathe differs from the common lathe in this, that the centre of the circle in which the work revolves is not a fixed point, but is made to oscillate with a slight motion while the work is revolving upon it, the tool being all the time stationary, and hence the figure will be "out of round," as the turners call it, or will deviate from the circular figure as much and as often as the motion is given to the centre

Rosin—Is an exudation from trees belonging to the *coniferæ* or fir tribe, and is the residue left in the still, after the oil or spirit of turpentine has been distilled It is very combustible, and is used in light ball and carcass composition

Roster—A list which regulates in succession the services of officers and men for regimental, garrison, and other military duties For regimental duty, the officers roster is kept in the Adjutant's office, for brigade duty, in the Brigade Major's office

Rotation, Veolcity of—A term used in gunnery to express the speed with which a projectile rotates at the mouth of the piece or along any portion of its path, which varies with the charge and twist of the grooves This velocity further depends upon the form, length, weight, and position of the centre of gravity of the projectile

Rotatory Motion—In gunnery is the motion given to a projectile fired from a smooth or rifled barrel In the former case, in consequence of the eccentricity of round shot, the shot acquires a rotation of which the axis and direction are altogether uncertain, in the latter, the rotatory motion is acquired on an axis parallel to that of the bore or coincident with the line of fire so that the direction of rotation is known This fixed rotation adds greatly to the steadiness of the projectile in its flight, and the deviation being a constant quantity can be calculated for by a scale of deflexion, or the gun can be sighted "true," when manufactured, so that no allowance is necessary except for wind

Rough Rider—In the artillery or cavalry, an instructor in equitation, and an assistant to the riding master One allowed to each troop or battery

Round—In artillery a "round of ammunition" comprehends the charge of powder the projectile, and the priming To fire one or more rounds is to discharge each gun in succession from a battery or portion of it, until the turn comes round for the first gun to fire again Light artillery (smooth-bore) can come into action and fire one round in 28 seconds, timing from the order "action front" to the discharge of the piece, and in 15 seconds, if the first cartridge and shot be carried in a box on the axle-tree *Vide* Rapidity of Firing

In a plural sense the term is applied in gun-drill to the change of numbers in the gun's crew, comprehended in the order *change rounds* In the same sense it may be applied to small-arm cartridges which are reckoned by rounds, as 20 rounds in pouch

Round Shot—Spheres of iron and steel fired from smooth-bored guns

Rounds—A patrol of soldiers detached at certain hours of the night from the main guard under an officer, to visit the several guards and sentries of a garrison or camp At other times

of the night, visiting rounds under a non-commissioned officer of the guard perform a similar duty

Route — An order for troops to march from one place to another It also expresses the road by which they are to move The *route* or line of march is appointed by the Quarter-Master General of the army, under whose orders, by direction of the Commander-in-Chief, all transfers or reliefs of regiments take place

Route, Column of—In artillery, one of the formations of a battery on a parade or march , it is the best for the latter, as it takes up in breadth much less room than any other formation It consists of sub-divisions or single carriages, each gun with its wagon, following in succession

Rubbers—Are strong heavy files generally made of an inferior kind of steel, they measure from 12 to 18 inches long, from ¾ to 2 inches on every side, and are made very convex or fish-bellied Rubbers are only for coarse manufacturing purposes, when the object is rather to brighten the surface of the work than to give it any specific form

Ruffle—A low vibrating sound, which is beat upon the drum, but not so loud as a roll It is generally performed in paying military compliments to General Officers, and at Military Funerals

Rule, Carpenter's—A common two-foot rule, jointed in the centre, for measuring timber

Rule, Gunner's — Is made either of box or ivory, and jointed in three places, for the convenience of carriage, with various tables of weight and dimensions of guns, shot, shell, &c , marked on it

Runners—The metal cylinders used in the incorporating mills of a gunpowder manufactory, termed properly *edge-rollers* They were formerly made of gun-metal, but iron runners have been found to answer equally well, and are much cheaper Iron runners, like gun-metal, become honey-combed after being in use for some time from the action of the saltpetre, if the metal has not been properly hardened They are about 7 feet in diameter, 18 inches broad, and from 4½ to 5 tons in weight

Running the Gauntlet—A punishment formerly enforced in the Navy, and which was inflicted also on soldiers As related by James, in his Military Dictionary, the mode of procedure was as follows When a soldier was sentenced to *run the gauntlet*, the regiment was paraded in two ranks, facing one another, each soldier having a switch in his hand, and as the criminal ran between the ranks, naked from the waist upwards, he was lashed by the soldiers While he ran, the drums beat at each end of the ranks Sometimes he ran three, five, or seven times, according to the nature of the offence

Happily such barbarous punishments no longer disgrace the Army or Navy

Rupee—An Indian coin, weighing 180 grains Troy, or one tolah The standard quality is eleven-twelfths silver, one-twelfth alloy, general value about 2 shillings English money Diameter of the rupee $\frac{1}{16}$ of a foot The tolah or imperial rupee is the standard of weight in India Compared with the English weights 32 tolahs make 1 lb Troy or 823 Avoirdupois

Russala—An Indian military term for a troop of horse, and applied to the native irregular cavalry

Russian Ordnance — Are chiefly steel guns of Krupp's manufacture, and consequently breech-loaders

Russuldar—A native irregular cavalry officer

Rust—Oxide of iron which forms on the surface of iron from exposure to atmospheric influences or contact with acids The following forms a good preservative against rust, and is the composition used on Armstrong guns in transit one part white lead, seven parts tallow

S.

Sabots—Are wooden bottoms attached to spherical projectiles by means of a copper rivet The object of the sabot is to keep the shot or shell in the axis of the piece, and by its cylindrical shape to cause the projectile to glide out of the piece without bounding up and down in the bore, by which it acquires a rotatory motion so prejudicial, from its uncertain rotation, to the direction of the projectile This uncertain rotation has reference only to shot and shell fired from smooth-bored ordnance

Sabre—A sword slightly curved towards the point It is used in the mounted service of the army

Sabretache—From the German *Sable*, a sabre, and *Tasche*, a pocket Usually an oblong leather case or pocket scolloped at the bottom with a device in the centre, and suspended from the left side of the sword belt by three slings of the same material as the belt It is worn by officers of the mounted branch of the service

Saddle — The seat on which a rider sits when on horseback A military saddle consists of the following principal parts 1, the Tree , 2, the Web , 3, Girth , 4, Flaps , 5, Seat , 6, Panel , 7, Surcingle , 8, Stirrups , 9, Leather (Stirrups).

The following form the requisites of a good saddle —

1 It should be as light as is consistent with strength

2 The pressure of the whole and each part should be distributed over as large a space as possible, having regard to the following, *viz* —

3 The weight should be placed upon the part of the animal best fitted to bear it

4 The shape of the seat should be such as to allow the rider to sit well down into it, and balance himself in every position of the animal

5 There should be no pressure on any jointed surface either of man, horse, or saddle A military saddle having to carry the rider's kit, is not as light as an ordinary hunting saddle

In the artillery service, the pattern saddle is termed "Universal" for all Gunners and Non-Commissioned Staff of the Royal Horse Artillery, and all mounted men, with the exception of Drivers, who use a modified saddle The "universal" pattern saddle is also issued to most cavalry regiments

Safe Conduct—In war time and under the circumstances of an enemy being shut up in a fortress, from which there is no egress, a *safe conduct* is a pass or permission granted by the General of the besieging force to any individual in authority in the besieged fortress, to proceed unmolested to the enemy's head-quarters should he desire to hold communication on any subject of importance

In the late Continental war, *safe conduct* was given to certain French officers leaving Metz and Paris to visit the Prussian head-quarters

Safety Valve—Is that important part of a steam engine without which it could not exist It consists of a small cover or stopper, sitting

loosely on or in a small aperture in the boiler, but kept down by a certain weight made to increase its effect by a lever, so that it may, by being slid along it, like the weight on a steel yard, serve without change of weights to vary the pressure which the steam is allowed to acquire This of course it cannot exceed without lifting the valve and escaping, until reduced below the limit thus allowed it The valve is simply the weakest or most yielding part of the boiler, and by taking care that it shall always be the weakest, the danger of explosion is avoided The safety valve is the invention of a Frenchman, Dr Papin

Saji Muttee—An Indian term for carbonate of soda It is found in many parts of India on the surface of the soil as a carbonate or sulphate of soda, in the proportion of 50 per cent of the former to 10 or 15 of the latter By washing, heating, and evaporation, the sulphate is converted into a sulphuret of sodium, which, by further heating and exposure to the atmosphere, is changed into carbonate of soda It is used in clearing off the old coat of paint from gun-carriages previous to applying the new one, and for removing grease, &c

Sal - Ammoniac — A compound of ammonia, and hydrochloric acid NH_4 Cl, and known as *Muriate of Ammonia* Since the establishment of gas works, it has been chiefly derived from the liquor obtained during the preparation of coal gas It is translucent and colourless, and is used in tinning, to prevent the oxidation of the surface of the copper

Saleetahs—An Indian term for bags used for wrapping up a soldier's bedding, &c, on the march Saleetahs are also used for packing the component parts of tents They are made of gunny cloth

Sally-port—A passage in old fortifications, from the body of the place towards the country through which "sallies" were made, which obtained for them the name of *sally-ports* The postern is sometimes called a sally-port

Saltpetre—*Vide* Nitre, in which is described the treatment of this article in the process of refining The following method of extracting saltpetre from damaged gunpowder may be found useful to officers in the Ordnance Department, who have not, in all probability, in arsenals the appliances of a gunpowder factory for carrying out the operation to the nicety required —

' A half-hogshead barrel must be prepared to stand over a common copper cooling pan , holes must be drilled in the bottom, and a stratum of fine sand, one foot deep, filled in , over this is to be placed a false bottom, also pierced with holes Four times the weight of powder, of pure well-water, must now be added to the damaged powder, and well worked together in a separate half-hogshead This mixture must be transferred to the filter by degrees, whence it will soon run in a clean stream The water must then be emptied into a magazine boiler, and over a fire, in a safe corner, be thickened down by evaporation to one half its quantity, when it will be found that crystals of pure saltpetre will form on any bit of common earthenware on which it is dropped This being the case, the liquor may be poured into a second cooling pan, and allowed to remain twenty-four hours, when a fine crop of clean crystals will be obtained The drawn-off water may be again reduced over the fire, and again placed to cool, and the operation continued until no water remains Should the crystals be discolored, they may be

re-boiled with a very small quantity of clear spring water

"By this operation over 50 lbs of pure saltpetre may be recovered at the expense of a little firewood, from every 100 lbs of damaged powder, and each magazine can thus supply itself with this necessary article"

Salute—A mark of respect, performed in different ways, according to circumstances An artillery salute consists of a certain number of guns having reference to the rank of the officer to be saluted, or the occasion on which the salute is fired The Queen's Regulations lay down the following

All royal salutes consist of *twenty-one* guns

The King or the Queen	21 guns
The Royal Family	21 guns
Days appointed for firing salutes as celebrations of anniversaries	21 guns
Viceroy of India	21 guns
Field-marshals and Admirals of the Fleet	17 guns
Commander-in-Chief in India	17 guns
Members of the Council of India while in office	15 guns
Admirals or Generals	*15 guns
Lieut Generals or Vice Admirals	13 guns
Rear Admirals or Major Generals	11 guns
Brigadier Generals or Commanders of the first class	9 guns
Return salutes to Commanders of the second class, Captains of the navy, and Officers of inferior rank	7 guns
Governor of Madras or Bombay (within the Indian Seas) Governors of H M 's Colonies, Foreign Possessions, Castles or Fortress (within the precincts of their Governments)	17 guns
Lieut Governors within the precincts of the said Governments (if administering the Government)	15 guns
Provincial Commander-in-Chief	13 guns
Agents to the Governor General	13 guns
Residents	13 guns
Chief Commissioners of Provinces and Commissioners	13 guns
Political Agents	11 guns

For salutes at Home, *vide* Queen's Regulations

For the form of salute and the order to be observed when a body of troops is to be inspected by the Sovereign, or Members of the Royal Family, or by General Officers, *vide* Queen's Regulations

Salvo—Any number of guns fired together at the same moment, simultaneous discharge of artillery

Sand—Is formed of very fine silicious matter There are three kinds of sand, *viz*, pit sand, river sand, and sea sand Sand for moulding purposes, such as is used in casting, is properly a yellow pit earth

Sandarach—A resin softer and less brilliant than shell-lac, but much lighter in color, it is therefore used for making a pale varnish for light-colored woods, and other works for which the dark color of shell-lac would be unsuited This resin is generally dissolved in spirits of wine, and with the lac varnish constitutes the basis of what are called *spirit varnishes*

Sand-bags—*Vide* Bags

Sandcrack—A complaint common to horses, caused sometimes in

* Should any of the Naval or Military officers entitled to a salute hold Commissions as Commander in chief, or Commanders of the Forces of a station, division or district, they are entitled to be saluted with two guns more than specified in the above scale, against their respective ranks

a dry country by treading for any length of time upon ground from which all moisture is absent, which by rendering the horn hard and dry causes the hoof to be brittle, and gives rise to sandcrack In India it is not at all an uncommon complaint Linseed, meal poultices, and covering the sole with cow-dung, are not bad remedies

Sand-shot — In artillery, small balls of iron cast in sand, instead of in iron moulds They are used in making up case and grape

Sap—A trench formed by Sappers, in making approaches under the fire of the besieged, the working party protecting themselves by filling gabions and placing them as fast as possible along the intended line of parapet When the fire of the enemy is slack, so that many gabions may be placed and filled at the same time, it is called a *flying sap* If two parapets, one on each side of the trench, be formed, it is then called a *double sap*

Sap-rollers—Are stuffed cylinders of brushwood, to cover the heads of saps, they are usually made 7 feet long, the diameter of the outer cylinder being 4 feet, and of the inner one 2 ft 6 in A finished 7-feet sap-roller weighs, when new, 14 cwt

Sap-shield—A steel plate mounted on wheels for the purpose of giving cover to the sapper in a single sap, should the earth thrown up by him not be of sufficient thickness to give him safe cover The shield in use is that invented by Sergeant-Major Knight, R E

Sappers and Miners — A body of men now known in the British Army as Royal Engineers, and forming the privates or working portion of that regiment They are kept at the head-quarters of the regiment for the purpose of being instructed in all engineering operations, and when required are detached to the colonies, or elsewhere, to aid, in time of peace, in building or repairing fortifications and other military works In time of war they are attached to the Engineer Park, and perform in a siege the engineering operations required, such as throwing up defensive works, digging the parallels or approaches, sapping and mining, &c , or in superintending and instructing working parties

Saturation—In chemistry, the solution of one body in another until the receiving body can contain no more A solution is said to be saturated with an acid or an alkali when the latter is added in sufficient quantity to render it neutral, and supersaturated when the point of neutrality has been exceeded

Saucisson — A long tube of linen, filled with gunpowder and laid in a wooden case or bamboo, to protect it from being trodden upon or misplaced It is used for exploding foul gasses or mines This name is also given to an extra large fascine

Saul (*Vatica robusta*)—A tree well known in India, especially in the North-West Provinces It is used in the construction of gun carriages As described by Condr Skinner, the wood is strong, tough, coarse-grained, and fibrous, not easily worked, and when dressed has a hard horny surface, and the fibres appear to be interlaced with each other A cubic foot of unseasoned wood weighs from 68 to 72 lbs This tree grows also in Assam and Burmah

Saw-band, Endless—There are two kinds, one for cutting wood and another for cutting iron By the latter, iron one inch thick can be cut into any curved form at the rate of 1½ inches per minute This saw is exten

sively used for cutting the brackets, transoms, and all irregular forms required in the manufacture of wrought-iron carriages

Saw, Bow—Or frame saw, also called the turning-saw or sweep-saw, is used for the general purposes of carpentry In using the bow-saw, the work is mostly fixed vertically, and therefore the blade is used horizontally , but the frame is placed at all angles, to avoid the margin of the work, and it is frequently necessary to twist the handles or pins during the cut to modify the position of the frame

Saw, Compass—Resembles the hand-saw in its general structure and in the form of its teeth, to allow them to be as a tangent to the curve

Saw, Hand—This nature of saw is used for ordinary purposes, such as preparing woods for the work required after they have been cut at the saw-pit into planks and boards The hand-saw is made taper in order that the blade may possess a nearly equal degree of stiffness throughout the greater width , it also facilitates the attachment of the handle Were the blade as wide at the point as at the handle or heel, it would add useless weight to the saw, which from the weight at the far end, would be more flexible at the handle than at the point

Saw-setter—An instrument for bending the teeth of the saw It consists of a narrow blade of steel with notches of various widths for different saws In using the saw-setter, the saw is allowed to remain in the clamps after having been filed, and the alternate teeth are inserted a little way in that notch which fits the blade most exactly, and they are bent over by applying a small force to the handle, which is either raised up or depressed equally for each tooth

Saw, Tenon—Is a smaller nature of saw than the hand-saw It tapers, and has a back to it of stout sheet iron or truss folded together It is used for fine and accurate work and for such work as its name denotes It has about 8 teeth to the inch

Scale—A line drawn upon wood or ivory, &c , and divided into parts, the lengths of which may be taken off by the compasses and transferred to paper

Scale, Diagonal — As described by Heather, is used when minute parts of a measurement are required, such as the tenth or hundredth part of an inch The diagonal scale is thus formed "Draw eleven parallel equi-distant lines , divide the upper of these lines into equal parts of the intended length of the primary divisions , and through each of these divisions draw perpendicular lines, cutting all the eleven parallels, and number them 1, 2, 3, &c , commencing from the second Sub-divide the first of these primary divisions into ten equal parts, both upon the highest and lowest line of the eleven parallel lines, and let these sub-divisions be reckoned in the opposite direction to the primary divisions, as in the simply-divided scales Draw the diagonal lines from the tenth sub-division below to the ninth above , and so on , until a line from the first below joins the zero point above Then, since these diagonal lines are all parallel and equidistant, the distance between any two of them in succession, measured upon any of the eleven parallel lines which they intersect, is the same as this distance measured upon the highest or lowest of these lines, that is, as one of the sub-divisions , but the distance

between the perpendicular, which passes through the zero point, and the diagonal through the same point, being nothing on the highest line, and equal to one of the sub-divisions on the lowest, is equal to one-tenth of a sub-division on the second line, two-tenths on the third, and so on, so that this, and consequently each of the other diagonal lines, as it reaches each successive parallel, separates further from the perpendicular through the zero point by one-tenth of a sub-division, or one-hundredth of a primary division"

Scale, Gunter's—This instrument is a flat brass rule, usually 2 feet in length, and about 1½ inches broad, having on one side equal parts, rhombs, cords, &c, as on the other plane scale, and on the other, the logarithms of these numbers, hence the lines on this side are called the logarithmic lines

Scale, Tangent—Is a rod of metal or wood made to slide in a groove at the breech of field and other ordnance having engraven upon it the actual lengths of the tangents to the different angles of elevation

The object of the tangent scale is to give elevation to a piece of ordnance beyond what the line of metal affords

In M L rifled guns, as described by Captain Stoney, R A, in his "Construction of our Heavy Guns," "*the tangent scale* has a flat steel bar, graduated on three sides, *viz*, on one of its narrow sides in degrees, on the other in yards, and on one of its flat sides in tenths of inch of fuze corresponding to the range scale

"For guns with less than 40 inches radius, the tangent bar is equally divided for degrees, but for those natures with a longer radius, the 9-inch, for example, the degree divisions regularly increase from 1° upwards Each degree is graduated into six divisions of ten minutes each For a smaller number of minutes than ten, there is a screw collar on the *land service* pattern, which can be turned round until the required number is in line with a *fleur-de-lis* marked on the sight

"The range scale is marked in hundred of yards corresponding to full charges, and must be found most useful in active service, as the enemy's distance being known, it is only necessary to elevate directly and bore the fuze for the corresponding range

"The nature of the gun is also marked on the sight bar, otherwise the wrong sight might be used—for the bars are the same in section for all natures

"At the top of the bar is a gun-metal cross-head, at an angle complemental to the deflection, in order that it may be horizontal when in the gun In the cross-head is a sliding leaf with a side motion, for the purpose of giving a regular allowance for wind blowing across the range, one wheel being higher than another, &c"

Scales—A kind of armour made of thin brass, laid like scales one over the other, for the protection of any part of the body, and used chiefly as shoulder and helmet scales

Scalet—An ancient term for a lifting-jack It was chiefly used in extricating wheels from deep ruts and soft ground

Scaling—In artillery, firing a small charge of powder from ordnance, before commencing practice, for the purpose of clearing the piece of any dirt or deposit which may be lying in the bore

Scaling Ladders—*Vide* Ladder's Escalade

Scantling—The transverse dimensions of a piece of timber in breadth and thickness It is also the name of a piece of timber, as of quar-

tering for a partition, &c All quartering under five inches is termed "scantling"

Scarfing—The junction of two pieces of timber by being bolted or nailed transversely together, so that the two appear as one

Science of War—The following, extracted from James's Dictionary, seems worthy of insertion —

"According to the author of the Nouveau Dictionnaire Militaire, the science of war, or the knowledge of military tactics upon an extensive scale, is perhaps the most comprehensive operation of the human mind, and demands the full exercise of all its powers To be equal to the multifarious branches of this unbounded art, the strictest attention must be given to military discipline The best authors, both ancient and modern, must be resorted to for information, and when the mind has been well stocked with the sound principles of theory, practice and experience must follow, in order to confirm what has been carefully selected from the first authorities, and maturely digested Courage, zeal, prudence, and discretion must likewise be the constant companions of those persons who would distinguish themselves in war, and it ought never to be forgotten that a scrupulous adherence to morality, a rigid observance of every social duty, and a manly subjugation of the many passions by which different men are differently agitated, must constitute the character of a real warrior These are the qualifications by which the science of war is distinguished from every other pursuit in life, and without these qualifications, a conqueror can neither be called a hero nor an able general, but only a lucky soldier We have, indeed, our military colleges and institutions, and so had the Grecians and Persians, not only for the instruction of the privates, but also for the education and formation of those individuals who were destined to be officers These colleges and institutions were under the superintendence of persons who had established their reputation by a knowledge, not only of the theoretical, but also of the practical branches of their profession Nobody could be admitted in the capacity of master or professor unless he had previously undergone several examinations respecting the science of war, both as to offensive and defensive operations These professors were called tacticians"

Scimitar — A short curved sword, chiefly used by Orientals, but worn in Europe during the 15th century

Scissel—The clippings or leavings of metal, such as are left after the manufacture of copper caps, tubes, coinage, &c

Scotching — A term used in artillery, to prevent a wheel from moving by the application of a *scotch* or wedge of wood This is rendered necessary in mounting or dismounting ordnance from their carriages

Scouts—Are generally horsemen sent out before, and on the wing of an army, at the distance of a mile or two, to discover the enemy, and give the general an account of what they see During the late war with France, the Prussian Uhlans were used as scouts with great advantage, and traversed the country for miles in advance of the army It is absolutely necessary to the success of an army, that such means should be resorted to for obtaining intelligence

Scratch Brush—A cylindrical bundle of fine steel or brass-wire

tightly bound in the centre, with the ends projecting at both extremities so as to form a stiff brush for cleaning and scratching metals preparatory to gilding and silvering, or as in the case of small arms, preparatory to browning them As well as the shape above described, there is another, in which the steel wire is fastened in long lengths on leather or cloth, and in this form is known as "scratch card"

Screw — One of the six mechanical powers used in pressing or squeezing bodies together, but sometimes also in raising weights The screw is a spiral groove or thread winding round a cylinder, and everywhere making the same angle with the length of it, so that, if the surface of the cylinder, with this spiral thread upon it were unfolded and stretched into a plane, the spiral thread would form a section of any inclined plane, whose length would be to its height as the circumference of the cylinder is to the distance between two threads of the screw When the spiral thread is upon the outside of the cylinder, the screw is said to be a *male* one, but if the thread be cut along the inner surface of a hollow cylinder, it is said to be a *female* screw

Screw-driver—An instrument for driving a screw, also for unloosening it Known commonly as a "turnscrew"

Screw-jack — An instrument for lifting heavy weights through short lifts, it rests by means of a large nut upon a hollow base or pedestal, and is raised or lowered by turning the nut

Screw-plate — A machine for cutting small metal screws wormed and notched, but furnished with several holes varying slightly in size, the worm being formed progressively by using holes gradually diminishing in size From 2 to 6 holes are intended for each thread, and are arranged in groups for the purpose Although the screw plate is sometimes used for common screws as large as from ½ to ¾ inch diameter, it is better to use die-stocks for all screws exceeding about $\frac{1}{16}$ inch diameter

Screws, Oscillating — Are elevating screws attached to heavy pieces of ordnance, either for batteries of position or siege service

Searcher — A gun implement There are two kinds of searchers, one with a reliever, and the other single-pronged, both used in examining the bores of smooth-bored ordnance The former consists of a number of steel rods, with a short stud at the end of each, which are compressed by the action of a ring attached to an iron rod which passes through the handle, on relieving the steel rods, and moving the instrument freely, the studs will discover any flaw, the extent and nature are then found by using the single-pronged searcher The French have a very ingenious and accurate instrument for ascertaining the exact internal measurement of guns, called the "*Etoile mobile*," which is now made use of also in the British Artillery *Vide* Star Gauge

Seasoned Timber — Timber which has been deprived of its sap and moisture and thus rendered dry and hard Before timber can be used, the juices must be got rid of from the capillary vessels, or the wood will remain moist and green for a considerable period, and the planks formed from it will be subject to dry rot In Europe, after the tree has been felled, barked, and roughly squared, it is thrown into either running or standing water the former is preferred, as the constant motion of the water carries away with it the juices from the wood

and the water more readily evaporates from the wood at a future period The length of time that timber should be seasoned depends on whether the logs are soaked in standing or running water, a longer period being necessary in the former case After being taken out of the water, the logs should be stacked in open and airy sheds, so as to allow the timber to dry thoroughly before it is taken to the saw-pit Various means have been devised for seasoning wood other than that described To season by steam is not so efficacious as the old and usual method of seasoning The following extract from a very useful little pamphlet on the timber of Bengal, by Mr W Clifford, showing that the method of seasoning in Europe is fatal to wood in India, is herewith given —

"Seasoning develops and consolidates all the good qualities of wood, and they reach their highest degree of perfection by gradual seasoning—results which can be reached in India by no other process, for experience has proved that forcing not only leads to greater loss in seasoning, but impairs the more valuable properties of the wood

"In Europe it is the practice, and experience must have decided its advantage, to give timber a preparatory seasoning in log, exposed to the weather In India it is simply worse than useless to do so The effect of two or three years' exposure is to cover the surface with deep sun-flaws, penetrating to the depth of 1½ to 2 inches, destroying effectually much of the best portion of the log for all purposes of the carriage-builder Long-continued exposure will render the log worthless If kept in log, it must be protected from the sun and rain, then good may result from the measure, but not even then in proportion to the delay and consequent loss of capital which it involves, for seasoning in log is a very tedious process It must be evident that the smaller the scantlings, and the greater the surface acted on, the quicker will be the process of drying A piece of wood that will take years to dry in the log, would dry better in as many months if cut to its required size, the ratio of drying being the same in both A saul plank 16″ × 1″ will take from six to eight months to season, a scantling 4″ × 4″ will take two years and eight months, the cubic contents of each being the same The result of exposure to saul timber, is to flaw the surface to the extent the drying proceeds, to close the pores of the wood, and to prevent the free evaporation of the internal moisture, and it will be found in converting the log, that it is nearly as wet inside as when first felled, so that the only gain is the absolute loss of the finest portion of the log, besides, timber, however well seasoned in log, always holds a latent proportion of moisture which is not set free till it is converted, or till the log attains a great age

"Therefore, if timber cannot be protected from the sun, it should be converted at once, and stored to season, and the sooner this is done the less will be the loss in conversion, and the quicker will the material be fit for use

"For this purpose the material should be cut into a half-wrought state,—that is to say, sufficient should be allowed over the finished dimensions to cover shrinkage, superficial flaws, warping and end splits A safe ratio of allowance in saul is 2 inches to the foot in length, breadth, and thickness, thus in the finished dimensions of large framings, 21′ × 12″ × 4½″, the half-wrought would be 24′ 6″ × 14″ × 5¼″, or, for

such a large scantling, it would be safer to make it 5⅜″ For sissoo and teak, the allowance may be reduced about one-third

"The material should be stored in a good shed, well ventilated The shed should be built at opposite angles to the prevailing winds, and be constructed so as to protect the material from the direct action of the wind from any quarter, for experience has proved that the material suffers quite as much from the dry winds playing on it as from the heat

"Advantage would be gained by lowering the temperature of the seasoning shed during the hot months, either by underground air ducts, or by the more simple plan of a bheestee's mussuck, what is wanted is to check the too rapid evaporation of the surface moisture, which, by the unequal contraction in shrinkage, has such a ruinous effect on saul Quick drying is not so much wanted as gradual and regular drying, for it will be found that what is gained in time is more than lost in material It is the extremes of our Indian climate that render seasoning such a difficult and and costly process

"All woods, even when dry, absorb moisture from the atmosphere in wet weather in a greater or less degree, of the woods I have noticed, saul the most, sissoo the least The best preservative against this is good paint"

Seat—This term is applied to the position of the shot in the bore of a piece of ordnance when rammed home

Secant—In trigonometry, a line drawn from the centre of a circle to the extremity of the tangent

Seconded—A term applied to officers on staff employ The place of officers on the seconded list is filled up, so that the effective strength of the corps does not fall below its number Seconded officers are permitted, on special occasions, and on being re-appointed, to be absent from their corps for 10 years, at the end of that time, they must return to regimental duty, or become Supernumerary The ordinary duration of absence from regimental duty is five years, which, in the case of manufacturing appointments, appears to be a great mistake, as the experience gained by the officer at the head of the Establishment is then most valuable to Government

Secretary at War—An officer appointed by the Crown to administer the affairs of the army He is responsible to Parliament for the efficiency of the army in men and *matériel* The Queen's Regulations define the correspondence on military subjects which should be referred to his office

Section—A cut made by a plane passing through a work in any direction

Sector—The sector of a circle is the figure contained by an arc, and the two radii drawn to the extremities of the arc

Seer—An Indian weight of 2lbs

Segment—A segment of a circle is the figure contained by an arc and its chord

Segment, Shell — *Vide* Shell Segment

Seizing—Lashing line, termed in ordnance nomenclature *line seizing*

Selection—A term which before long will be better known in the army than it has hitherto been, as the Act, now before Parliament, for the abolition of purchase, states that officers are to be promoted by *selection*, which means that merit only is to be the guiding principle in their future advancement

Semaphore—A mode of com-

municating intelligence by means of signals It generally consists of a tall post in which there is certain machinery consisting of movable arms for making the required signals

Semelle—A French term signifying a movable plank upon which the breech of a gun rests The term is not in use in the British Artillery

Sentence—The judgment of a Criminal Court allotting the punishment of a convicted person In Courts Martial, the sentence is arrived at by the votes of the Court In voting on the sentence, the decision goes with the majority of voices, the president having a second or casting vote in case of equality Officers who have voted for an acquittal must vote on the sentence, but no sentence of death can be passed unless two-thirds of the members of the Court concur therein

Sentinel or Sentry—Derived from the Latin *sentio,* I feel, or more likely from the Italian *sentinella,* a private soldier placed in some post to watch the approach of the enemy, to prevent surprises, to stop such as would pass without order, or being discovered who they are Such is James's definition, who further describes the duties of a sentry "Sentries are placed before the arms of all guards, at the tents and guards of general and commanding officers All sentries are to be vigilant on their posts, they are not on any account to sing, smoke, nor suffer any noise to be made near them They are to have a watchful eye over the things committed to their charge They are not to suffer any light to remain or any fire to be made near their posts in the night-time, neither is any sentry to be relieved or removed from his post but by the corporal of the guard They are not to suffer any one to touch or handle their arms, or in the night-time to come within ten yards of their post.

"No person is to strike or abuse a sentry on his post, but when he has committed a crime, he is to be relieved and then punished according to the Articles of War"

In planting sentries, regard must be had to the duty on which they are to be engaged If before the enemy they should be doubled, and placed in the most advantageous position for hearing and observing any alarm in front By day they should be placed on a height in the most commanding situation, by night they should be withdrawn lower down, but still able to see any approaching party When sentries hear people approaching them by night they must challenge them, order them to halt, and allow only one person to advance until they are satisfied that they are *friends* By day sentries must not allow more than one stranger at a time to approach their post on any pretence Picquet sentries must be relieved every hour of the night

Sepoy—A native soldier who has enlisted into H M's Native Army in India Regiments of Native Infantry are commanded and officered by European officers, but there are also native officers attached to each Company subordinate to the European officers

Serang — An Indian term, and applied to the head lascar of a vessel's crew His position is similar to that of boatswain of a European crew.

Serge—*Vide* Cloth

Sergeant—A non-commissioned officer next in rank above a corporal, and attached to a company or troop for the purpose of aiding the commanding officer in maintaining discipline and good order, in instructing the soldier in his duties, and in fact in implanting

in him all that is soldier-like and good There are several distinctions of sergeants in a regiment, such as colour sergeant, drill sergeant, pay sergeant, &c

The arm of a sergeant is a short breech-loading rifle

Sergeant-Major—The senior non-commissioned officer in a regiment His duties are of a very important nature, as will be realised when it is considered that he is the Adjutant's right-hand man In him should be embodied all that is manly, soldier-like, and zealous His duties are so manifold that for the proper performance of them he should be the smartest and most intelligent man in the regiment, and his example and conduct such as shall cause him to be esteemed and respected by every soldier in it

Serpents—In pyrotechny, decorations with which rockets are charged

Servants — In a military sense, are soldiers taken from the ranks for the purpose of waiting upon officers This privilege of having a soldier-servant is not granted on Indian service, or where a colonial allowance is granted in lieu of servants Each *infantry* regimental officer is allowed to have *one* soldier to attend on him, field officers and adjutants keeping horses for regimental purposes, as well as all *cavalry* officers when present at head-quarters or employed on duty, *two* each *Vide* Queen's Regulations

Service—In a military sense, all duty performed from the time an officer enters the army until he leaves it The term is also used to express the amount of service an officer has seen before the enemy To express the particular service an officer may be in, as land or sea service, &c The term admits of a variety of significations

Set—In artillery, another term for the "dip" of an axle-tree arm.

Setter, Fuze—A wooden instrument, the mouth of which is slightly hollowed out it was formerly used with the aid of a mallet to set the fuze into the shell, but this is no longer required Mallets and setters, therefore, form no part of the detail of a set of fuze implements with field guns

Sextant—The pocket sextant is a surveying instrument, which will measure the actual angle between any two objects to a single minute It requires no support but the hand, and is easily adjusted *Vide* Heather on Mathematical Instruments

Shabraque—A large sized saddle cloth placed over a cavalry or horse artillery officer's saddle

Shackle—In artillery material, is the iron ring attached to a triangle gyn, from which the block and tackle is suspended It is fastened to the upper part of the prypole and cheeks by means of a bolt called the "shackle bolt" The term is also given to the ring at the end of the shaft of an anchor.

Shaft—In military mining, is the perpendicular passage sunk from the surface of the ground to the required depth, from which the branches of the mine diverge, termed "galleries" The common mode of proceeding is to sink a square shaft or well to the necessary depth, and from the bottom of this shaft to drive out a gallery of the length required, so as to lodge a sufficient charge of gunpowder in a chamber at its extremity, which, by its explosion, will destroy the enemy's work Shafts and galleries are lined with timber, to prevent the soil from breaking in

Shafts—Are attached to all gun carriages, and consist of an off and near shaft, the former fixed to the axle-arm outside the wheel, passing

through an iron loop underneath the end of the splinter bar, the latter in the same position as the pole formerly occupied, *viz*, underneath the centre of the splinter bar, where it is pinned and keyed from above

Shako — The head-dress of the British infantry

Shank—The bone of the leg, the shaft of an anchor, to one end of which the flukes are attached, and to the other, the shackle

Shaping Machine — That known as Mr Whitworth's, is particularly adapted for shaping levers, cranks, and connecting rods, also for work in general

Sharp Affair — A contest in war, of a vigorous nature

Sharp Shooter—A good marksman

Shear-steel—Is produced from blistered steel, which, to prepare it for forging into edge-tools, requires to be condensed and rendered uniform by the process of *shearing* The process is also called *tilting*, on account of a tilt hammer being used

Shears — An instrument for cutting sheet metal

Sheave—Is a wheel fixed to a block turning on a pivot A groove is formed in the edge of the wheel, in which the rope runs, the wheel revolving with it The object of the sheave revolving with the rope is to remove, to a certain extent, the friction, which would otherwise prove a great impediment to the efficiency of the power

Sheep-shank—A knot in common use, serving to shorten a rope without cutting it or unfastening the ends.

Sheers — Are contrivances for raising heavy weights, and in the Artillery Service are used for raising guns out of boats, also for raising them on the ramparts of a fortification and other positions in a fortified work where the gyn cannot be used They are formed of masts or large spars set across each other at the upper ends

Shell—A hollow projectile What is termed in artillery a *common shell*, contains a charge of gunpowder, which is ignited by means of a fuze at the required moment, and which bursts the shell into several fragments, causing great destruction Formerly, the bursting charge in shells was limited, but common shells are now filled with gunpowder, which renders them more destructive and less eccentric The thickness of metal in a common shell is about one-sixth of its diameter, sufficiently strong to withstand the shock of the discharge within the bore of the gun, and the shell weighs about two-thirds the weight of a solid shot of the same diameter Common shells are provided with sabots, attached in the same way as to shot, and opposite the fuze hole When carried loaded, a small gutta-percha wad is driven down the fuze hole to keep the powder dry and prevent its escape, this being further secured by a metal plug These shells are fired from smooth-bored guns and howitzers at low angles against troops in line or masses, especially when posted behind cover, and may be used to advantage in destroying buildings, earthworks, or vessels

Shell, Common, for B. L. and M. L. R. Guns—Is a hollow cylindrical casting with a conoidal head, prepared for the reception of a bursting charge of powder, and coated with lead like the segment shell, having the fuze hole at the conical end, which is fitted with the General Service bush

Shell, Diaphragm—The invention of Lieut-Col (now General) Boxer, R A It is a shrapnel shell,

and used with smooth-bored ordnance It has a wrought-iron partition or diaphragm which separates the bursting charge from the bullets The channel of communication, termed the loading hole, from the exterior of the shell to the powder chamber, into which the bursting charge is poured, is closed and opened by a small screw The bursting charge in this shell is considerably reduced, and the interior of the shell is coated with marine glue, in order to ensure complete separation between the powder of the bursting charge and the coal-dust thrown between the bullets The bursting of the shell is facilitated by four grooves formed in its interior surface which act as so many lines of "least resistance"

Shell Guns—Those at present in the service are the 10-inch and 8-inch, which are associated with the usual armament of vessels of war, they are also employed in fortresses, coast batteries, &c They are of the following dimensions and weights —

	ft	in	cwt
10-inch	9	4	86
8-inch	9	0	65
8-inch	8	0	54

The 8-inch of 54 cwt is now mounted on a travelling carriage, and might be usefully employed as a siege gun this gun is the most suitable piece for the armament of caponnieres and flanks of works

Shell, Mortar — A hollow projectile of dimensions to fit the following mortars *viz*, 13, 10, 8, 5½, 4⅖ inch Mortar shells are issued loose, and filled with bursting powder when required They are fired from mortars at high angles,—the larger nature, with the object of setting fire to buildings, ships, or other combustible constructions, and by their penetrating power to explode magazines, the smaller nature, to annoy or drive out troops behind parapets or cover

Shell, Segment—Consists of a thin cast-iron cylindro-conoidal shell, enclosing a series of segments of the same metal, cast separately, and built up in layers on an iron disc having a cylindrical chamber in the centre, the segments are held together by a thin coat of alloy of lead and antimony, which is run over the surface of the shell from the base to the shoulder, the alloy also runs into the interstices between the segments, and coats the powder chamber The form of the outer portion of the lead in this shell is the same as that of the solid shot and common shell a small bursting charge is used with it It can be used as shot, shrapnel, or case, and was so for some time, but there are now three kinds of shells for rifled ordnance,—*viz*, a segment shell, common shell, and shrapnel shell (Boxer's) A description of the shells, with the fuzes used with them, will be found in Captain Orde Browne's Treatise on Ammunition

In the experiments carried on at Dartmoor, in 1869, between the shrapnel and segment shells, the Committee were in favor of the former as a time shell when used with a time fuze, and of the latter when used with a percussion fuze It appears from the report that the effective results from both were great when used as above shown, and the Committee have recommended a proportion of each to be carried with rifle batteries,—the shrapnel as time shells, the segment as percussion shells

Shell, Shrapnel—The invention of the late General Shrapnel, R A It is a hollow sphere of cast-iron, having less thickness of metal than a common shell,—*viz*, about one-tenth of

its diameter, and its weight about half that of a solid shot of similar diameter This nature of shell is filled with bullets and the bursting charge poured among them, which is ignited by a fuze, the bullets proceeding on their course with the same velocity which the shell had on bursting The object in using shrapnel shell is to give the projectile at long distances the power and efficacy of case shot, it is most effective when used against masses of troops, and the fuze should be so adjusted as to cause the shell to burst 50 yards short of the object fired at This pattern shell is now obsolete, having been superseded by Col Boxer's Diaphragm Shell, which is only used with smooth-bored ordnance

Shellac—*Vide* Lac

Shelling—Assault of a place by means of shells, bombarding

Shelter Trenches—As stated in the Instruction in Military Engineering, 1870, the increased power of the improved rifled arms of the present day renders it more than ever necessary that cover should be provided for troops in action This cover can be best obtained where natural cover is not at hand, by means of small trenches called *shelter trenches*

As explained in the above quoted work, "it is essential that there should be ready means of getting in and out of these trenches both to the front and the rear, it is also desirable that they should not offer any great impediment to a forward movement, and that troops should be able to march straight over them when necessary At every 100 yards or so, to enable guns, cavalry, &c, to pass, slight ramps should be formed, or intervals left in the trenches, which may at these places be made to overlap

"The most rapid way for infantry to obtain cover, is by the excavation of a trench 2 feet wide and 1½ feet deep, the earth is thrown to the front, so as to form a parapet 1½ feet high, the interior slope being built up as steep as possible with sods, clods, &c Such a trench can be executed by men with their accoutrements on, and distributed at from 4 to 6 feet intervals in from 10 to 20 minutes"

Shield—Defensive armour of very ancient date, and worn even at the present day amongst nations where civilization has not made much progress Shields have been made of wood, iron, and basket work, and were carried on the left arm in defence, while the right arm wielded the sword or spear

The term "shield" is also given to those massive structures of iron which are used as an outer casing to the granite or brick walls of masonry of a fortification, or as covers to an embrasure Shields of all dimensions representing the sides of plated armour ships have been set up from time to time at Shoeburyness, for the purpose of testing their resistance to rifled projectiles

Shoes, Powder—Are made of leather, unblackened, and sewn together They are of larger dimensions than the usual shoes They are used in all mill-houses where the manufacture of powder is carried on, and no one is allowed to enter a powder-house without first slipping them on

Shot—An iron sphere cast either solid or hollow There are several projectiles designated *shot,—viz*, round, (solid and hollow), case or canister, grape, bar, and chain shot, the two latter not now in use Since the introduction of rifled artillery, elongated shot have been introduced and are used with both breech and muzzle-loading

guns, with the former, Armstrong's solid shot, and with the latter, Palliser's shot of 12, 10, 9, 8, and 7-inch calibres

Shot, Case—*Vide* Canister

Shot, Chilled—Shot formed by pouring liquid grey cast-iron into a cold metallic mould, so as to cause the most sudden cooling possible By this process, which has been introduced by Major Palliser, the surface of the shot is rendered extremely hard, and capable of penetrating iron-plated ships It has been found only necessary to chill the head of the shot and to let the body be cast in sand *Vide* Moulds for casting Shot or Shell

Shot-garlands—Are used to retain shot placed on defences, they are made either of iron or wood Hitherto garlands have been made of cast-iron and of a square pattern, but they are to be used up and replaced by wrought-iron of a rectangular form They preserve the shot from deterioration, and it is usual to place a tier of unserviceable shot under the serviceable pile

Shot-gauge—*Vide* Gauge

Shot, Grape—*Vide* Grape

Shot, Hollow — Were introduced into the Naval Service with the 8 and 10-inch shell guns before iron-plated ships were built, with the view of enabling ships to carry a comparatively light gun with projectiles of larger diameter and less charge of powder than are required for solid shot In long ranges the hollow shot is undoubtedly inferior to solid shot, and it is only in short ranges, when the hollow shot can penetrate a wooden ship's side, that the magnitude of the fracture, as well as its splintering and shattering effects will be greater than those produced by the solid shot In long ranges the hollow shot is very liable to lateral deviations, as might be expected from its lightness, the deviations taking place principally near the further extremity of the trajectory

Shunt Gun—A muzzle-loading rifled cannon, introduced by Sir W Armstrong, on what he terms the *shunt* principle In the shunt gun, the projectile is introduced into the piece on ribs or buttons, but with this peculiarity that the projectiles enter by one set of grooves and come out by another set, or, as it is elsewhere explained, when the shunt gun is loaded, each stud presses against the *loading* side of the groove, and so runs easily home, being *shunted* on its way down into the narrow portion of the groove, but on coming out again, it presses against the *driving* side, and near the muzzle rises up the incline into the shallow part, or on the *high level*, and so is slightly compressed The projectile therefore leaves the bore fitting tightly, and with its axis stable

Sicklegħar—An Indian term A native of India employed in arsenals for cleaning metal work

Siege—A regular organized attack on a fortified position, by means chiefly of artillery

The term comes from the French *siege*, which signifies a seat, chair, &c Hence to "sit down before a place" signifies, in a military sense, to choose a position from which you may commence the necessary operations to attack and get possession of it

Siege Artillery — Before the introduction of rifled guns, siege artillery consisted of the 24-Pr gun of 50 cwt, the 10 and 8-inch howitzer, the 10 and 8-inch iron mortar, and the 5½ and 4⅖-inch brass mortar It now consists of the following, with the proportions shown for what is termed a *Siege Train, viz*

25 ⎧ 7-inch (72 cwt), B L R guns
20 ⎨ 64-pr ⎫ „
30 ⎩ 40-pr ⎭ „
15 10-inch mortars (Iron)
15 5½-inch „ (Bronze)

As explained in Lieut-Colonel Owen's Modern Artillery, from which the following information is obtained, the object of siege artillery is the reduction of the enemy's stronghold or fortress, and, therefore, the proportion and strength of the artillery to be used will depend on a variety of contingencies, such as the size of the fortress, its strength, the number of guns in the place to be attacked, as well as the strength of the garrison which defends it

The quantity of powder will be regulated not only by the number of rounds, but also by the charges employed, and which will depend upon the duration of the siege and vigour of the defence A wide margin, however, should be given in the amount of powder accompanying a siege train, a few barrels extra being advisable Fifteen hundred rounds per gun, inclusive of case, shrapnel, and carcasses, is the utmost limit which has been assigned for iron ordnance The above, however, is the calculation of ammunition required for the attack of a first-class fortress, which can be modified for the attack of smaller fortresses The number of men required for a siege equipment is as follows, allowing ten men for the detachment of a gun, five for that of a 10-inch mortar, and three for that of a 5½-inch mortar the proportions for three reliefs would be—

30 men per gun
15 „ large mortar
9 „ small „

Sieve—An instrument for separating the smaller particles of substances from the grosser In the manufacture of gunpowder, sieves are indispensable for separating the different sizes of grain They are made of wire of different dimensions, and are known by the number of meshes to the linear inch

Sights on Ordnance—Are those points or notches on the breech, muzzle, centre, and trunnions of a gun, by means of which the piece is laid on any distant object Smooth-bored land service cast-iron guns are provided with Millar's sights, consisting of a graduated tangent scale at the breech, and a dispart sight in front of the 2nd reinforce A wooden tangent scale is also used for elevation over the *clearance* angle

Heavy muzzle-loading rifled guns are sighted like breech-loading guns, *viz*, with *barrel-headed tangent sights*, and a *trunnion sight* on each side of the gun, they have in addition short centre, hind, and fore-sights Heavy muzzle-loading guns have therefore three pairs of sights attached to the gun

Signal Lights—Are used instead of blue lights, being equally bright and far more portable They were at first ignited by a percussion cap, afterwards by means of a detonating primer, but this pattern has lately been superseded by the magnesium light During experiments made between Southend Pier and the shore in 1869, service signal lights were tried a distance of 1¼ mile against similar signals prepared by Mr Abel with magnesium in the composition the latter had a marked advantage

Signal Rockets—*Vide* Rockets

Silence—In an action to "silence the fire" of the enemy's guns, is to disable his artillery in such a way that he is unable to reply

Simultaneous Loading — Firing with fixed ammunition

Sine—Is a straight line drawn from one extremity of an arc, perpendicular to the diameter, passing through the other extremity The sine of a quadrant 90° is equal to the radius

Sinnet—A kind of knittle used as a *seizing*

Sissoo (*Dalbergia Sissoo*) — A wood used in India in the construction of ordnance carriages and other works As described by Condr Skinner, the wood is close-grained, hard, and flexible, of a dark purple colour fading to brown A cubic foot of unseasoned wood weighs from 60 to 65 lbs

Skeleton — The framework of anything In a military sense, the term is applied to the diminished state of a regiment from casualties in the field or from sickness

Skeleton Drill—The method of instructing officers and non-commissioned officers in drill, when a sufficient number of men cannot be collected to form a battalion in single rank As explained in the Field Exercises and Evolutions of the Infantry, a skeleton battalion is formed of companies composed of two, four, or eight men each, representing, if there are two, the flanks of the company, if there are four, the flanks of half companies, if there are eight, the flanks of sections The intervals between the flanks are preserved by means of a piece of rope held at the ends to its full extent By this means any set or number of manœuvres may be performed

Skids—Are slabs, either of wood or iron, for placing guns, stores, &c, on, to keep them off the ground

Skin, Sheep—Is used in a standing battery to put over the muzzle of a mortar or howitzer to prevent the fuze being ignited from sparks falling into the bore, also for wiping the bottoms of shells of all sand and dirt that may have clung to them before loading

Sheep skins are also used for cavalry and artillery purposes, being placed over the shabraque, and as a covering for the valise

Skirmish — A loose desultory kind of engagement between small detached parties

Skirmishers—Detached parties of light horse or marksmen sent out in front of a regiment, &c

Slat Bar—Is the bar of a siege howitzer limber between the splinter bar and bolster, and which connects the futchels together

Sleepers — Form part of a gun platform on which the flooring of the platform is laid, and to which it is fastened either by screws, spikes, or rack-lashings Sleepers must be well embedded in cuts or trenches, and firmly fixed or pinned into the earth, then covered with planks, and finally completed with ribands and rack-lashings on each side

Sleighs—Are a particular pattern of carriage used for the transport of artillery in countries where much snow falls, such as Canada The carriages of the country are termed "sleds," and when artillery was sent to Canada in 1862, the sleds were found very useful and better adapted than our sleighs The term *sleigh* is also given to the carriage on which heavy guns are moved in store The mode of moving this nature of carriage is by means of rollers placed underneath the sleigh and worked by hand-spikes

Slewing—To slew a gun or mortar, strictly speaking, is to turn it on its axis without moving it from the spot on which it rests This is called

slewing the trunnions If the piece to be slewed rests on skids, a hand-spike is placed close to it on each skid, bevel up, and on that side of it towards which it is to be turned This is then called "scotching" or "chocking"

Slide-rest—Is an appendage to the turning-lathe, so contrived as to hold a tool firmly to the work, and while cutting a shaving from the bar in the lathe, the tool is slid gently along, and the bar is turned quite true There are two slides to the rest, by the separate or combined motions of which the tool can be made to act along or across the work with great accuracy, the attendance of a workman may even be dispensed with, by attaching a *star* to the wheel, and an iron *finger* to the end of the work in the lathe as the work revolves, the finger will bear down one of the points of the star, the effect of which is the same as turning the screw handle, by which the tool is moved along the surface of the work

Slide Valve—A form of valve in which the opening and closing of the orifice is regulated by a sliding plate Its most common application is to the steam engine, to govern the admittance of steam to and from the cylinder, its movements being controlled by a moving part of the engine called the *eccentric*

Sling—An ancient weapon, the invention of which is attributed to the Phœnicians or to the inhabitants of the Balearic Islands

Sling, Cart— Used for moving heavy guns, not exceeding 65 cwt, and 8 and 10-inch mortars, on hard, level roads The cart weighs 15 cwt, and is a two-wheeled carriage

Sling, Gun—A sling for lifting a gun off its carriage when placed under the gyn It is formed of 6-inch white rope for heavy guns, of a length to suit the dimensions of the gun or other object which is to be slung. It is fixed to the gun in the following manner in Heavy Gun Exercise —

"No 10 passes one bight of it under the cascable, and 11, by twisting, reduces the length of it, so that when fixed it may be as close to the surface of the piece as possible No 11 then holds his bight of the sling in front of the face of the piece, and No 10 passes the fid through the bights into the bore"

Sling, Shot—A sling for carrying heavy shot or shell It is made of canvas or gunny-cloth

Sling Wagon—A cart, on four wheels, employed in moving heavy ordnance, standing carriages, and traversing platforms, to longer distances than a sling cart is capable of doing

Slips—Are wrought-iron cylindrical cases about 4½ feet long by 2 feet 5 inches in diameter, in which wood for gunpowder purposes is distilled, the cases are fitted with lids, and are made to fit into iron retorts, which are imbedded in masonry in such a manner that the heated air from the furnace shall circulate freely round them, and thus convey an equable heat to all parts of the retort throughout the operation of charring In each slip there are two holes, which correspond with similar holes in the retort, and through which the gases from the wood pass off in the process of distillation The charge of dhall stalk (the wood used in India) for a slip depends upon the size of the wood If of large size, the slip will hold 150 lbs, medium 70 lbs, and small size 50 lbs

Slopes—In fortification, are the various inclinations on the formation of a rampart, parapet, &c, and are expressed usually by fractions in which the numerator represents the height

and the denominator the base of the slope Thus a slope described as $\frac{2}{1}$ (or verbally as two in one) is one in which the vertical height is twice the base, whilst that expressed by $\frac{1}{2}$ (or verbally as one in two) is, on the contrary, one in which the base is double the vertical height

Slot—A long cut or narrow opening The application of the *slot* may be seen on the upper surface of the Armstrong gun for the introduction and removal of the vent piece

Slotting Machine — As described in Brande and Cox's Dictionary, is a machine in which a tool moves vertically, in the manner of a mortising chisel, so as to cut out slots or mortises, or to pare round the edge of any object requiring to be made fair and smooth on the edge Slotting machines are used for a great variety of purposes

Slow-match—*Vide* Match

Sluice—A flood-gate for regulating the flow of water It is made either of wood or iron, usually sliding in a vertical frame

Sluice Gate—In fortification, is a strong vertically sliding door, placed in a batterdeau, to regulate the flowing of the water in the ditch Sluices are used besides for retaining and raising the water of a river or canal, and when necessary to give it vent

Small-arm Ammunition—Is the ammunition used in the various small-arms of the service In England, it is made up at Woolwich, and in India, at the factories in Bengal and Bombay The most important bullets used in the manufacture of our service cartridges are the Enfield, Whitworth, Westley-Richards, and Metford's percussion bullet

Ammunition used for the converted Enfield, a breech-loader, and known in the service as the Snider rifle, is termed the *Boxer ammunition*, which is suitable for all Snider rifles, 577 bore It is, as explained in General Lefroy's Hand-book of Field Service, on the central fire system The case is formed of a coil of thin sheet of brass covered with thin paper, which has been found to preserve the cartridge from the effects of hurt or damp better than the old pattern Enfield cartridges The bullet of this cartridge has a hollow in it to receive a clay plug like the Enfield, and the lower end of the bullet is cannelured to contain the bees'-wax, with which this part of the bullet is coated The position of the centre of gravity is adjusted by means of a hollow in the head, which in manufacture is spun over with the surplus lead at the apex of the bullet The charge of powder is $2\frac{1}{2}$ drachms Weight of bullet hitherto has been 530 grains, it is now 480 This ammunition is stated to be perfectly waterproof

Small Arms—Include all hand fire-arms, smooth-bore or rifled In the Appendix will be found the small-arms used in the service, most of which are rifled The latest introduction is the Martini-Henry rifle, which is considered, as regards its shooting qualities, a superior weapon to the Snider on account of its low trajectory

With reference to the different systems pursued in rifling, they are too numerous to find insertion in a work of this kind, but the most conspicuous are herewith given,—*viz*, the Whitworth rifle, which has an hexagonal bore, the Westley-Richards carbine, an octagonal, the Lancaster carbine, an elliptical, and the Snider, or converted Enfield, which is grooved much like the Woolwich system employed for ordnance

For some time to come, the Snider

rifle will be used in the service, until a sufficient number of Martini-Henry rifles can be manufactured. It is an admirable weapon, simple and safe, and little liable to get out of order

As compared with the Prussian needle gun, the Snider rifle is a superior weapon It is much more simple in construction, and lighter, and can be fired more rapidly

Smart-money — Is the sum paid by the recruit as discharge money from military service after he has received the enlisting *shilling*, but previous to his being attested before any Justice, on his showing that his enlistment was irregular The amount of *smart money* is twenty shillings

Smelting—The process of separating metals from the earthy and other matters with which they are combined in the state of ore

Smoke-ball — Consists of a paper shell (the thickness of the paper depending on the nature of the shell) and is filled with a composition which, upon igniting, evolves a large volume of smoke It is thrown into mines or other confined situations, to suffocate the enemy's working parties

Smoothing Plane — A small hand-plane without a handle or *toat* It is used for smoothing the surfaces of bodies

Snaffle—A horse's bit, and the most common bit in use

Snaking—When the spiral motion of rotation of an elongated projectile round its original direction, (caused probably by irregular resistance and want of homogeneity) becomes of exaggerated extent, the projectile may be seen to describe a sort of helix round its primary direction, and the accuracy of shooting is greatly influenced by the part of the helix which may first happen to come in contact with the ground Projectiles subject to this influence are technically said to *snake*

It is also described as the observed motion of an elongated projectile through the air, caused probably by uneven resistance due to a certain unsteady motion in the axis of the projectile

This unsteadiness, or *wobbling*, may be caused either by insufficient rotation being communicated in the bore of the gun, or by the subsequent action of the air, the pressure of which causes an instability of rotation, and thus an irregularity in the amount of surface which the projectile presents to the air

Snap-cap — A small leather cylinder with a metal top of the size of the hammer of a percussion musket and fitting closely on the nipple It is used to preserve the nipple from the action of the hammer

Snare—The sounding cord of a drum

Snatch Blocks — Metal blocks which are made to open on one side, to allow the rope to be lifted in and out of the block without putting its end in first

Snifting Valve — The air or blow-valve in a steam engine It receives its name from the peculiar noise made when the air having all bubbled out of the cylinder (from the steam being let in), the steam begins to follow, and instead of escaping in bubbles, is instantly condensed by the water with a kind of decrepitation

Socket, Port-fire — A metal tube or receptacle for receiving a port-fire It is so made that one-half of the socket falls back on a hinge to receive the port-fire, and is closed again with a running ring

Soda Water Bottles — Be-

sides being used as shown under the head of "Bottles," can be turned to good account as hand grenades, and as such are more convenient from their lightness, for throwing to a distance, than the iron spherical grenade

Sola—The name of a plant stated in Balfour's Cyclopædia to be common in moist places, and, in the rainy season, in many parts of the plains of India It belongs to the genus *Æschynomene* The plants are remarkable for their light and spongy texture, and seem indeed to be composed almost entirely of pith This light substance is collected in the dry season, and applied to a variety of uses, particularly for hats, which afford a good protection against the sun

Soldering — As described in Weale's series, "is the process of uniting the edges or surfaces of similar or dissimilar metals and alloys by partial fusion In general, alloys or solders of various and greater degrees of fusibility than the metals to be joined, are placed between them, and the solder, when fused, unites the three parts into a solid mass , less frequently the surfaces or edges are simply melted together with an additional portion of the same metal"

In applying the solder, it is of importance that the edges to be united should be chemically clean, and as in this state they have a strong affinity for oxygen, they are protected from the air by means of some flux The usual fluxes are borax, sal-ammoniac, chloride of zinc, &c A good liquor for tinning or soldering can be prepared from a mixture of chloride of zinc and muriate of ammonia, as follows Dissolve 3 oz of zinc in a pint of muriatic acid, letting it stand in a warm place about 8 hours Strain the solution through a cotton or linen cloth, add a tea-spoonful of pulveriezd sal-ammoniac to a pint of the solution, and let it boil for ten minutes , when cool, it is fit for use

Soldier—Derived from the Latin *soldarius*, one who serves for pay In the common acceptation of the term, a soldier is one who enlists to serve the government for certain pay and privileges in the way of promotion He forms one of a body for the protection of the country from outward invasion and for keeping down all internal dissensions, and, in short, for protecting the interests of the country at home and abroad

Sole — A veterinary term That portion of a horse's foot which, together with the bars and frog, comes in direct contact with the ground

Sole of an Embrasure—In fortification, the foot or bottom of the embrasure

Solution—The term "solution," in its widest sense, is applied to the perfect union of a fluid with another substance, no matter whether gaseous liquid, or solid But we call solution more properly *absorption*, it the dissolved substance is *gaseous*, if *liquid* the term *mixture* is more frequently made use of The application of the term *solution*, in its usual and more strictted sense, is confined to the perfect union of a *solid* substance with a fluid

Solvent—In chemistry, the liquid in which a solid is dissolved

Soondree — (*Heriteria mino*— A wood used for poles and shafts of carriages and spokes of wheels It is thus described by Conductor Skinner "The wood is strong, fibrous, and flexible, tolerably close and straight grained not very durable, of a light red colour turning to a reddish brown, and easily worked A cubic foot of unseasoned wood weighs 75 to 80 lbs.

Soorkey—Pounded brick dust, much used in India for building purposes, in combination with lime, to make mortars, stucco, &c It has the property of making lime hydraulic, taking the place of the European pozzuolana and other hydraulic cements

Sortie—A dash made by the beseiged against the investing army *Vide* Sally-port

Sound—The sensation produced in the organs of hearing by the vibrations of the air or any other elastic body, whose condition of equilibrium is momentarily disturbed Sounds are propagated to great distances, and with remarkable distinctness over a surface of water or ice It is stated that at the bombardment of Holmia, in Sweden, in 1658, the sound was heard 180 miles from the scene of action, and in the fight between England and Holland, in 1672, the report of the guns was heard at a distance of 200 miles

Sound, Velocity of—At the temperature of 33°, the mean velocity of sound is 1,100 feet in a second It is increased or diminished half a foot for each degree of temperature above or below 33°

Spanner—A screw wrench, used for the purpose of tightening nuts upon screws

Spatula—A wooden slice or instrument used in mixing inflammable or detonating compounds

Spavin—A veterinary term Any bony growth or bony enlargement in a horse, however small, which is to be seen or felt upon the inner side of the back, is a *spavin*

Speaking Trumpet — An instrument which, on being applied to the mouth, carries sound to a considerable distance It was formerly used in large armies, and at the siege of Gibraltar, General Elliott (afterwards Lord Heathfield) caused the words of command to be given by means of the speaking trumpet

Spear — A weapon having a wooden shaft mounted with a sharp steel point It has been known and used from time immemorial, first as a hand or missile weapon, and subsequently as a pike or lance

Specific Gravity—*Vide* Gravity, Specific

Spent—In gunnery, an expression used in speaking of the diminished velocity of a projectile when it has nearly come to rest

Spew — In gunnery, to run at the mouth, applied to a gun when, from too quick a fire, it bends at the chase, or the muzzle droops.

Spherical Case Shot—*Vide* Shrapnel Shell

Spikes—Form a portion of the stores of a battery They are made of steel, and are of two kinds, *common* and *spring* They are used to render ordnance either temporarily or permanently unserviceable The following is one of the modes and the readiest one, though not the most permanent Take the *common spike*, which is 4 inches long, 27 in diameter at the head, and about 1 at the point, drive it as far as it will go into the vent, and afterwards break it off close to the gun The next is the *spring* or temporary spike, which is 17 in diameter, and has a flat head, to prevent its falling through the vent into the bore, and also a spring about two inches in length, which extends from the point towards the head In passing through the vent, the spring is compressed, but as soon as it is clear of the metal it expands, and cannot be withdrawn, unless it is again compressed sufficiently to allow it to be

drawn again into the vent This may be done by pressing the rammer head against it, provided the spring be towards the muzzle, which is known by a small notch cut in the head of the spike, to point out its direction The point of a bayonet, or of a ramrod, or a common nail, will make a very good spike, if no spike is at hand Further, to render a gun unserviceable, the cap-squares, elevating screw, and any small supports the gun is dependent on, should be taken away, or wrap a shot in a piece of cloth—a neckcloth or stocking will answer—and jam it hard home with a rammer

Spindle—In moulding, this term is applied to the rod upon which the core for shells is formed Also the wooden spindle upon which a gun mould is made In mechanics it denotes the axis of a wheel or roller

Spirals—As described in Cape's Mathematics, are transcendental curves, which derive their name from making several revolutions round a fixed point, and receding at the same time continually from this point. There are various kinds of spirals named according to their properties or their discoverers, and known as the spiral of Archimedes, Hyperbolic spiral, Logarithmic spiral, Parabolic spiral, &c

Spirit-Level – An instrument for adjusting, in truly horizontal positions, instruments which are used in surveying and in astronomical observations, and which is attached to such principal instruments It consists of a glass tube, differing from the cylindrical form by having its diameter largest in the middle, and decreasing slightly and with great regularity from the middle to the ends The tube is nearly, but not quite, filled with spirits of wine, thus leaving in it a bubble of air, which rises to the highest part of the tube, so as to leave its two ends equi-distant from the middle, when the instrument is in adjustment.

Spirits of Turpentine — Is obtained by distillation from certain *coniferæ* or fir-tribe trees It is known in commerce as *turps* or *terps* The source of common turpentine is the *pinus sylvestris*, and its collection is an important branch of business in America It is used in the Ordnance Department for mixing with paints

Spirits of Wine – *Vide* Alcohol

Splicing—Is the joining of two ends of rope without a knot the instrument used for the purpose is a marline spike There are two kinds of splice, short and long To make a short splice, untwist from 4 to 8 inches of each of the two ends of rope, and interlock the strands up to the close parts of the rope, those of the two ends alternating, hold in the left hand one end of the rope with the loose strands in front, and cross each strand of that end over the strand of the other end which is to the left hand of it, then by means of the marline spike pass it under the same strand of the second end, and draw firmly on the strand which is passed through Pursue the same course with the strands of the second rope To increase the strength of the splice, pass each strand round the one on its left a second time, and cut off the loose ends The short splice is used for slings, block straps, or when the rope is not intended to pass through blocks To make a long splice for a rope which is to pass through a pulley, the short splice being too thick, untwist about 8 inches of the two ends, and interlock as before, untwist a strand of one end from the close part of the rope and replace it by the strand of the other rope which

comes to hand, cross the end of the latter strand over the one which is replaced, and pass it under the adjacent strands. Substitute, in this manner, every other strand of the other rope, and cut off the loose ends The long splice is used to unite two ends of a rope which is to pass through a block

Splint or Splent—In veterinary practice, a bony tumour on the inner and lower part of the knee-joint of a horse The best treatment for this malady is conveyed in the old maxim "Time and patience" Rest will do more than physic To check the further enlargement of a splint, employ the following ointment —

Iodide of lead	1 oz
Simple ointment	8 ,,

Apply with friction, thrice a day

Splinter Bar—The wooden bar of a limber, which connects the futchels or framing pieces of the carriage with the axle-tree bed by means of iron stays at the ends The traces of the wheel horses are attached to the splinter bar

Splinter Proof — In fortification, a building strong enough to resist the splinters of bursting shells

Splinters — Fragments of exploded shells

Spoke—A portion of a wheel, the tenon of which is fitted into the nave In gun carriages, each wheel has twelve spokes, on the extremity of which the felloes are fastened, and which form one continued circle

Spoke-shave — A small iron plane something like a penknife, set in the middle of a frame, which can be used with both hands It works easily in the direction of the grain, and is used for shaping and smoothing small rounded surfaces This instrument is used by the carriage-maker, cooper, saddler, and other artizans

Sponge—This beautiful and useful article comes from the shores of the Bahamas, from Greece, Tunis, Turkey, and other countries It is of different qualities and texture, and is used with batteries in cleaning the harness, and for other battery purposes

Sponge Buckets—For siege and field carriages, made of wood or leather They hold water for washing the guns, watering the cattle, and other purposes

Sponge Cloth—A peculiar kind of cloth, moist with oil, it is used to clean the screws of Armstrong guns, and is made of cloth so woven that no fibre comes off in use by which the worms of the screws could be clogged

Sponge, Gun — Consists of a rammer-head, staff, and sponge-head block It is used for cleaning out a piece of ordnance after it has been discharged Sponges are of different dimensions and forms, according to the nature of ordnance they are required for Sponge-heads are covered with wool or fleecy hosiery

Sponge, Washing—For cleaning the bores of ordnance, it is made of oakum, jute, or old rope, lashed to a wooden stave

Spontoon—A long pike or lance which was formerly (about a century ago) carried by officers in the British army

Spun Yarn—*Vide* Rope

Spur Wheel—In machinery, a wheel which has the cogs or teeth on the edge or periphery, projecting radially from the centre

Squad—A division of a company for purposes of interior economy Also any small body of soldiers told off for drill or any particular duty

Squadron — One of the main divisions of a cavalry regiment con-

sisting of two troops It is the unit of cavalry tactics

Square—A military formation of troops, of which there are two kinds, the *solid* square, which faces outwards, having for its object to resist cavalry, and the *hollow* square, in which the men face inwards, for the purpose of hearing orders, &c, read, this being the most compact form in which all the men of a regiment can hear simultaneously

The name "square" is given in carpentry to a steel blade, with the stock at right angles to it This instrument is used by carpenters to ascertain, when pieces of wood have been planed, whether the surface and sides are at right angles to each other

In Geometry, a square is a four-sided rectilineal figure, of which all the angles are right angles, and all the sides equal

Square Root—A number considered as the root of a second power or square number or a number which multiplied by itself produces the given number Thus 8 is the square root of 64, $\frac{1}{8}$ is the square root of $\frac{1}{64}$

Staff—Officers attached to the various branches and departments of the army, in subordination to superior authority, to carry out the multifarious duties of the service

A Chief of the Staff is appointed to an army in the field, and under his authority are the Adjutant-General and Quarter-Master-General, the heads of the two most important departments of the Army The duties of the Chief of the Staff are to superintend and direct all the branches of the Service, and he is responsible for the thorough efficiency of the whole mechanism of the army It is in contemplation, if not already carried out, to appoint a Chief of the Staff to the British army

Staff College — As described in Brande and Cox's Dictionary, is the school of instruction in the British service, for officers who wish to be placed on the staff of the army The following are the qualifications for admission A previous service of not less than three years, a certificate as to character and efficiency from the commanding officer, a certificate of good health and fitness for active duties from a military surgeon, a certificate of having passed the examination for the rank of a captain The candidates undergo a competitive examination in mathematics, modern languages, surveying, and military history, and the successful ones undergo a course of two years' study in the same, and other subjects, at the Staff College There is then a final examination, after which each officer is attached for a short time to each of those branches to which he does not belong He is then qualified to hold a staff appointment Only a limited number of officers can study at one time at the Staff College—about thirty.

Staff Corps—A regiment raised in India after the mutiny of 1857-58 All officers of the cavalry and infantry were invited to join it, and special advantages were held out to attract them to it, such as promotion by length of service, and certainty of receiving the Colonel's allowance after 38 years' service With few exceptions, most of the officers of the services above mentioned joined this Corps, as well as a few artillery officers who were permitted also to be transferred to it, but under very special circumstances, amounting to almost total exclusion

From this Corps officers are drafted to regiments and appointed to staff situations

Amongst other advantages offered

by the constitution of this Corps, is that of the transference of young officers of Her Majesty's British Army to it, if they have not exceeded 7 years' service

Staggers.—A complaint with which horses are sometimes afflicted, termed also vertigo, a kind of giddiness

Stampede—Terror and confusion among flying troops

Standard.—A flag, or banner Standards are carried by heavy cavalry regiments only The Royal Standard, or colour, in the Guards, is never to be carried by any guard except that which mounts on the person of the Sovereign In all large forts or garrisons, the Royal Standard is hoisted on the Sovereign's birth-day

Staple.—A loop of iron which passes through the opening in the hasp, and to which the padlock is attached *Vide* Hasp

Star—In military life, a star is an order, or decoration, also a mark of rank, worn by officers on the collar of the regimental coat, sometimes alone, and sometimes in conjunction with the badge of the crown, according to the rank of the officer

In astronomy, the general name for all the heavenly bodies They are distinguished as *fixed* and *wandering* stars, the former are those which have usually been observed to keep the same distance with regard to each other, the latter to change their places and distances, and are distinguished by their particular names of *planets, comets, satelites,* &c

Star Forts—Field works, proposed to remedy the defects of redoubts which have the ground before their angles undefended by a flanking fire By this tracing a cross fire is brought upon the ground before the angles, but, in consequence of the great exterior slopes necessarily given to field profiles, the lengths of these faces are greatly diminished, affording but a feeble quantity of fire from each, and for the ditches, the flanking defence amounts to nothing Baron Jomini says that "star forts are the very worst description of fortification They cannot have flanks, and the re-entering angles take so much room from the interior space, that there is no room for troops or artillery"

Star-Gauge—As described by Lieut Simpson of the U S Navy in his Naval Gunnery, "is an instrument used to ascertain whether the bore of the gun throughout its length is of the proper dimensions It is called the 'star-gauge' from the shape of its head, which is of brass, with four steel sockets—two movable, two stationary—for the *measuring points* There are four measuring points for each calibre, and when two of these are screwed into the fixed sockets, the distance between their points is equal to the true diameter of the bore The movable sockets rest against the inclined sides of a slide or wedge, whose sides incline 35 inch in a length of 2 2 inches, so that by pushing the slider the 35th part of this distance (about 06 inch), the distance between the two sockets or the measuring points, if screwed into their places, is increased 01 inch The slider is fastened to a square steel rod consisting of three parts, which are screwed together according to the length of the bore to be measured This rod passes through a brass tube which is also made in three parts, and to screw together This tube is graduated into inches and quarter inches, commencing at the plane of the measuring points, so as to indicate the distance of these from the muzzle of the gun The handle is of wood attached to a brass cylinder or socket, through which the

rod passes into the handle The socket of the handle slips over the end of the brass tube made smaller for the purpose, and has a slit in it allowing the brass tube to be seen through On the side of this slit a scale is constructed, to indicate the movement of the measuring points Each joint of the long tube has a mark on it, to show the position for the zero of the scale when the instrument is properly adjusted for any particular calibre In this position the handle is fixed to the sliding rod by means of a screw clamp

"To adjust the instrument, a ring-gauge, or ring of metal for each calibre, is used The handle is loosened, the proper measuring points are screwed in, the ring-gauge placed on them, and the slider pushed out until all the points touch the inner circumference The zero of the scale is then made to coincide with the mark on the tube, and the handle clamped, when the instrument is ready for use A rest in the form of a T is placed in the mouth of the gun to keep the instrument in the axis of the piece Commencing at the muzzle, the diameter of the bore is measured at intervals of a calibre, as far as the trunnions From that point to the seat of the shot, a diameter is measured at every inch and for every quarter of an inch, for the rest of the bore No variations over 03 of an inch are allowed, and that must be in excess"

Staring-coat—Applied to the skin or coat of a horse, the hairs of which stand erect This appearance is either from bad care of the animal, or happens at the change of the season when winter sets in

Stars—The beautiful decorations of rockets, observed when the head of the rocket explodes

Statics—The science which considers the weight of bodies, or the motion of bodies arising from gravity

Staves — Long narrow pieces of wood which, when braced together, form the sides of casks or powder-barrels In India, powder-barrels are made of teak , in England, usually of American oak

Stay-irons—The iron rods which connect the ends of the axle-bed to the splinter bar

Steam—Water expanded into an aeriform state by the addition of heat Water boils at 212°, and at that point gives off vapour

Steam-Engine--The following description is taken from Weale's Series —

" *Steam Engine*, a machine for deriving power from the expansion which results from the conversion of water into vapour or steam by the application of heat This expansion is so great that a given quantity of water becomes, when changed into the form of steam, enlarged to about 1,728 times its original bulk, and this expansion takes place with a force that may be termed irresistible Thus if water be enclosed in a vessel, say of iron or any other strong material, and the water be expanded into steam, and insufficient space left for the expansion, the vessel will be burst by the force of the steam within A steam engine consists essentially of a vessel into which the steam is admitted, and which is provided with a moveable disc, closely fitting the interior and capable of sliding within the vessel This vessel is made cylindrical, because this form gives the greatest strength, and is the most readily fitted with the movable disc The vessel is termed the *cylinder*, and the disc the *piston* Supposing the cylinder to be placed upright and fitted with a close cover,

and that while the piston is near the bottom of it steam is admitted to rush in through a pipe below the piston, the piston will be driven up by the steam, and if, when it reaches the upper part of the cylinder, the steam from below is shut off, and admitted through an upper pipe to press upon the top surface of the piston, it will be forced down again Thus a rectilinear motion up and down is produced, and this constitutes what is called the *principle* of the steam engine All its other parts are for the purpose of regulating the admission of the steam, and converting the rectilinear motion produced by the cylinder into a rotary motion at the point where the power is required to be applied for working machinery The steam, when no longer required for that purpose, is allowed to escape into the open atmosphere, or conducted in a pipe to another vessel, which, being cooled by the application of cold water, rapidly condenses the steam,—that is, re-converts it into water If permitted to escape into the air, the steam has to force itself against the pressure of the atmosphere, whereas if conducted into a condenser, this force is not required Hence steam of less pressure will work what is termed a *low-pressure* or *condensing engine*, while that already described is for distinction called a *high-pressure engine* A third variety of steam engine is worked by shutting off the steam before it has driven the piston the whole length of the cylinder, or completed the *stroke*, as it is termed, and the subsequent expansion of the steam completes the impulse upon the piston Engines thus worked are distinguished as *expansive engines* The principal difference in the mechanism of condensing and expansive steam engines is in the movement of the apparatus which admits and shuts off the steam, or the *valves*, which act as doors within the pipes The several parts of a condensing engine and its appliances are as follow 1stly, the *boiler*, in which the steam is produced from water by the action of fire in the furnace beneath , 2ndly, the *steam-pipe* in which the steam is conveyed to the engine , 3rdly, the *steam-chest* in which the steam is received, and which communicates with the two *induction-pipes* that lead into the upper and lower part of the cylinder , 4thly, the *cylinder* fitted with the *piston*, and having pipes called the *eduction-pipes*, through which the steam passes away, when its work in the cylinder is completed, into the condenser , 5thly, the *air-pump*, which abstracts the water formed by the condensed steam, sending it into the boiler, producing a partial vacuum within the condenser, and thus assisting the escape of the steam from the cylinder, 6thly, the *condenser* itself, which is kept cool with water pumped up by the cold-water pump The piston has a rod fixed to it, which works through a steam-tight opening or *stuffing-box* in the lid of the cylinder, and this *piston-rod* is attached to one end of a *beam*, which turns upon a centre, and the other end of which works a *connecting-rod* attached to a *crank*, to the side of which a rotary motion is thus imparted In some engines the piston-rod is connected by links directly with the crank, and these are hence termed *direct-action* steam engines, while the former are distinguished as *beam-engines* In others, again, the piston-rod is attached to the crank without links, and the cylinder, instead of being fixed, is made to vibrate or oscillate these are therefore termed *vibrating* or *oscillating engines* *Marine engines* for propelling

vessels on the water, and *locomotive engines* for propelling trains of carriages upon railways, are each distinguished by peculiarities of construction and arrangements fitting them for their especial duties "

Steam Gauge—A contrivance attached to steam engines which indicates the pressure of steam on the boiler

Steel Guns — In the British Artillery, steel guns have not been introduced, except a few mountain batteries Steel is an expensive metal, and doubts have been entertained as to its durability for guns In the manufacture of our heavy guns, a steel lining only is used, which is surrounded with coils of wrought-iron, shrunk on In many of the continental countries, steel guns have been preferred to any others, especially in Prussia, which possesses a foundry carried on by Mr Krupp, whose steel guns have received a wide-world fame, and have been adopted by Russia, Austria, Belgium, and many of the minor German States The guns are all breech-loaders, a system discarded to a great extent in the British Artillery

Notwithstanding the fame of these guns, some of the trials, especially in Russia, have been anything but satisfactory , and it is stated that, in the late Franco-Prussian war, no less than twenty-five guns burst in one of the corps-d'armée attached to the Prussian army

Steel Yard—A balance by means of which the weights of bodies are ascertained by a single standard weight The steel yard is a lever having unequal arms , on the shorter arm the body to be weighed is placed, and on the longer the standard weight is placed, which moves backwards and forwards on the arm until it touches a point which counterpoises the body being weighed Divisions are graduated on the longer arm, which indicate the weight of the body weighed

Stencilling—A method of producing the picture of an object without drawing it It consists in simply tracing off on paper the objects which it is desirous to delineate on some smooth surface The object having been traced, the parts to be delineated are cut out, and the vacant spaces rubbed over with colour on the wall or surface to be painted , on raising the paper, the picture will be observed below Stencilling is greatly resorted to in decorating the walls of rooms It is used also largely in factories, where there is much marking, the address being cut out on thin metal, and then rubbed over with paint It saves much labour and expense Powder and other barrels are so marked

Steps—In the artillery service, the brackets of naval and garrison carriages have steps made on them, which provide a fulcrum for the hand-spikes in elevating or depressing the gun

Sterro-metal — An alloy composed, as prepared at the Royal Gun Factory, Woolwich, of copper 60, zinc 44, iron 4, tin 2 It is said to be the invention of Baron de Rosthorn of Vienna It derives its name from a Greek word signifying " firm " It has a brass yellow colour, is close in grain, is free from porosity, and has considerable hardness, whereby it is well adapted for bearing metal, or other purposes where resistance to friction is needed

Sterro-metal possesses another quality which, in reference to its application to guns, is regarded as more important than its tenacity,—namely, its greater elasticity , but it has never been used for guns

Stirrups—A kind of rest for a

horseman's feet, they are attached to the saddle by means of leather straps, 3 feet long, and 1½ inches wide The present pattern-stirrups are similar to those of a hunting-saddle The stirrup irons are of shear steel The lance stirrup has a leather bucket attached to it, for the butt of the lance

Stock—The nave of a wheel, the handle of a tool

Stock with Taps and Dies—Are of three sizes, large, medium, and small A set of either size comprises a stock, 3 dies of sizes, 9 taps, or three to each die, named entering, second, and full tap, and a wrench The dies and taps are made of cast steel, the former for cutting screws on bolts, the latter for internal screws, as in nuts

Stockade—May be termed a solid barricade of timber, for intrenchments or redoubts The Burmese resort very much to this mode of defence, also the New Zealanders The best way to attack a stockade is to either blow it up with powder-bags or with gun-cotton Shot or shell of the largest nature make very little impression on it *Vide* Bags

Stoking—The operation of feeding a furnace with coal It requires much attention, skill, and experience It may often happen that two stokers do not stoke alike, the bad stoker burning more coal, at the same time keeping up less steam The secret in stoking is this,—that the coal should be broken up into small pieces, and, when thrown on the furnace, should be so placed as to cover the whole surface of the grate, and prevent cold air from coming up between the bars into the furnace, which would reduce the temperature, and consequently the amount of steam

Stone—A weight of 14 lbs A mounted non-commissioned officer of artillery with his appointments weighs 18 stone, 13 lbs

Stone Coal—Another name for anthracite South Wales abounds in this nature of coal

Stone, Oil or Turkey—For sharpening tools, such as chisels, planes, &c

Stone Shot—Used for ordnance up to the 16th century The class of ordnance with which they were used were not made strong enough for heavier projectiles Stone shot were also discharged from mortars *Vide* Pierrier

Stool Bed—In ship or garrison carriages, the stationary bed on which the breech of the gun rests On this bed a quoin is placed for elevating the gun

Stopper—A plug placed in the muzzles of small-arms to keep the bore free from rust, and to prevent dirt from entering into the barrel It is made of cork or India-rubber, having a brass top To make it thoroughly serviceable, the cork or India-rubber should be covered with serge or flannel

Stopper-hitch—A knot for stoppering the fall of a tackle, &c

Stoppering a Fall—Making fast the fall of a tackle to some fixed object, at a point intermediate between the moving and standing ends

Storm—To make a vigorous assault on any position occupied by an enemy

Stratagem—Artifice in war It is thus mentioned by Col Macdougall in his Theory of War "The success of a stratagem depends mainly on the commander's knowledge of human nature in general, and of his opponent's character in particular Its object is to deceive your enemy as to your designs If you desire a general action, spread reports of the weakness of your army and appear to avoid one If the

contrary, put on a bold face, and appear desirous to engage The employment of stratagem is particularly applicable to operations having for their object the forcing of any long line which it is impossible for an enemy to guard at all points, such as mountain ranges, rivers, entrenched lines, &c "

Strategical Point — Colonel Macdougall, in his Theory of War, states as follows "Every point on the theatre of war, whatever be its nature, which conduces in any manner to strengthen your line of operation or of communication, is a *strategical point*

"*Decisive strategical points* are those only which are decisive in insuring the success of any operations of strategy either for offence or defence" Thus, any point, as is shown elsewhere, may, by the relative situations of the hostile armies, become a decisive strategical point, but the points most likely to do so are strong positions commanding the principal great roads, or a permanent bridge over a great river, or blocking up the approach to passes over a range of mountains

Strategy — Is the science by which a general is enabled to trace the plan of a campaign, determining the positions of which it is necessary to be master, and fixing the direction in which the communications should be established Strategy has also been defined as the art of placing in a certain position, at a certain time, a body of troops in fighting order superior to that body which your enemy can then oppose to you Strategy relates to the movements of an army on the theatre of war, when not in actual contact with an enemy, and merges into *tactics* on the field of battle

Streak or Strake—Iron plate fastened in pieces to form the tire round the circumference of gun-carriage wheels This method is still pursued in the Home Service in tiring large wheels The artillery wheels of both light and heavy carriages in India have one band of iron for the tire

Strike — An expression made use of in dismounting or taking down a gyn, also in taking down the tents of a camp thus, to "strike a tent" is the usual expression

Studs — Are projections on the surface of projectiles used with rifled guns, for the purpose of making the shot take the grooving of the gun, of steadying the shot or shell in its passage out of the piece, and of preventing the body of the projectile resting on the bore

The form of studs on the upper surface of the 9, 8, and 7-inch muzzle-loading rifled guns, is made to coincide with the grooves in the gun, instead of being concentric with the projectile

The studs of all heavy projectiles, except the 7-inch, are made of an alloy of 7 copper and 1 tin, those of the 7-inch projectiles are 10 copper and 1 tin, and, again, those of the 9-Pr and 7-Pr M L R guns are made of zinc, and fastened on in the same way as those of the projectiles for the pieces rifled on the Woolwich system, *viz*, by being pressed into under-cut holes in the projectiles

Stuffing Box — Is thus described in Bourne's Catechism on the Steam Engine "The hole on the cylinder lid, through which the piston rod passes, is furnished with a recess called a 'stuffing box,' into which a stuffing or packing of plaited hemp is forced, which, pressing on the one side against the interior of the stuffing box, and on the other side against the piston rod, which is smooth and polished, prevents any leakage in this

situation The packing of this stuffing box is forced down by a ring of metal tightened by screws This ring, which accurately fits the piston rod, has a projecting flange, through which bolts pass for tightening the ring down upon the packing, and a similar expedient is employed in nearly every case in which packing is employed "

Subahdar—A native officer of the Indian army whose position corresponds with that of a captain in a European company of infantry

Subaltern—Literally means below another The term is applied to the junior commissioned officers in the army under the rank of captain

Sub-division — In artillery, a gun with its wagon

Sulphur—A yellow brittle mineral found in different parts of the world England receives its supply from Italy and Sicily In India it is obtained from the Persian Gulph, Sinde, Sumatra, and Burmah ,—most volcanic regions yield it Before it can be used for gunpowder purposes, it has to be distilled to free it from all impurities, and especially from all acids The following is the process pursued, at Waltham Abbey, in refining sulphur, taken from the late Major Baddeley's pamphlet "This combustible elementary body is formed generally in great quantities in the neighbourhood of volcanoes, it is also obtainable from metallic ores, and readily fuses At 170 deg of Fahrenheit, it begins to evaporate, at 185 to 190 deg it melts, at 220 deg it is perfectly fluid, and at 600 deg it sublimes Sulphur is purified simply by melting, that which is supplied to this establishment has been once refined, and the following is a description of the apparatus and method for purifying and rendering it fit as an ingredient in gunpowder A large iron pot is set about 3 feet on the ground, or about the height that an ordinary boiling copper is placed, having a furnace underneath This pot has a movable lid, which is fixed into the top of the pot with clay, and in which lid is an iron conical plug that can be removed at pleasure, from the pot lead two pipes, one to a large circular dome, and another to an iron retort rather below its level, the last-mentioned pipe has a casing or jacket round it, which can be filled with cold water, the communication of these pipes with the melting-pot can be shut off or opened, as occasion requires, by a mechanical arrangement About 5½ to 6 cwt of the once-refined sulphur is broken up into small pieces, placed in the iron melting-pot, and subjected to the action of the furnace, the plug in the lid and the pipe leading to the dome are now left open, but the pipe to the retort closed After about from two to three hours, a pale yellow vapour rises, when the plug is put in and the vapour conducted into the dome, where it condenses in the form of an impalpable powder, commonly called Flowers of Sulphur, a small pipe leads from the bottom of the dome on the opposite side into the water to allow the escape of the air, and sulphuric acid is taken up by this water In about 1½ to 2 hours after, the vapour becomes a deep iodine colour, when the communication with the dome is shut and the one to the retort opened, at the same time, cold water from a tank above is allowed to pass into the jacket we have before mentioned surrounding this pipe, the vapour then distills over, is condensed in the pipe, and runs into the retort below in the form of a thick, yellow fluid When nearly all has distilled,

which can be known by the jacket getting cold, the communication is again closed with the retort, and the fluid sulphur left an hour to get sufficiently cool to ladle out into moulds, the furnace door and the communication with the dome at the same time are again thrown open, that the rest of the vapour may pass into the latter, the Flowers of Sulphur thus obtained are used for laboratory purposes, being unfit for the manufacture of gunpowder from the acid they contain, and the crystaline sulphur, after being allowed to cool in the moulds, is barrelled up, and used as the third ingredient in gunpowder To ascertain the purity of sulphur, if a small portion is burned, on a piece of porcelain, no residue should be left, also, if it is treated with distilled water, litmus paper should not be discolored"

A complete description of the process of refining sulphur, with plans of the refining apparatus, is given in the Hand-Book of the Manufacture and Proof of Gunpowder, lately published by Capt F M Smith, R A, Assistant Superintendent of Gunpowder at the Royal Gunpowder Factory, Waltham Abbey

Sumpter Mules — The baggage mules of early English armies were called *sumpter mules* The term is obsolete now in the British, but is still retained in the American, army

Superficial Measure—The measure of surfaces or area, also called *square measure*

Super-heated Steam — Steam heated above the temperature due to its pressure It is used as a means of economizing fuel

Superior Slope — In fortification, the slope of the parapet towards the country

Surcharged Mine — *Vide* Compression, Globe of

Surcingle — A girth made of strap leather, and attached to the saddle It consists of a long body and short strap, and is buckled with exactly the same degree of tightness as the girth, the buckle being placed so as just to touch the lower edge of the near flap of the saddle

Surgeon—A medical officer, who is attached to, and in medical charge of, a regiment or brigade of artillery He is assisted by one or more medical officers subordinate to himself As senior medical officer, he remains always with the head-quarters of the regiment, when any portion of it is detached There are also Staff Surgeons attached to the army, who are usually employed in General and Garrison Hospitals *Vide* Medical Department for the relative rank of medical officers in the army

Swage Tools — Are rounding tools for the heads of screws, collars, flanges, &c

Sweep Bar—Is the rear bar of a siege howitzer limber, which connects the futchels

Swingle-tree—Is for draught purposes, and is fastened to the splinter bar on the near side of the shaft

Switches — As described in Brande and Cox's Dictionary, are movable rails, which are used to deflect a train from one line of rails on to another They are fixed at one end to a centre, while the other end, which is tapered to a point, is moved against the side of the rail by a horizontal rod and handle, to which a heavy weight is attached to bring back the switch to its normal position as soon as the handle is released Switches are either single or double, the first being made with one movable rail, and the second with two,

Swivel-Gun — In artillery, a gun fixed on a swivel either on the back of an animal, such as a camel, or on a wall, or any commanding position

Sword—An offensive weapon consisting of a steel blade, long and pointed, flat or triangular, and slightly curved, encased in a sheath of steel, brass, or leather The handle has a guard and pommel, in which the tongue of the sword is rivetted It is a weapon in general use throughout the world, and is the arm of the British cavalry The mounted artilleryman's sword is a cavalry sword, the dismounted, a bayonet sword

T.

Table, Round—The Knightly brotherhood of the Round Table was instituted as a distinction for military merit, by King Arthur, son of Uther Pendragon, called by James in his Dictionary third son of Constantine It consisted of twenty-four Knights, of whom the King himself was chief, who came from all parts to the court at Camelot, to give proof of their prowess in arms To avoid jealousies and questions of precedence, King Arthur caused a round table to be made for these festive gatherings, whence the Knights were called Knights of the Round Table At Whitsuntide in each year, they used to meet in full conclave at Winchester, where may now be seen, what tradition asserts to be the famous Round Table itself, though the learned in such subjects say that its date is not of greater antiquity than the reign of Henry VIII

Tabling—The process of letting one piece of timber into another so as to form one solid piece This method is very often resorted to when wood of sufficient scantling is not to be obtained for any particular work, such as the beam of a gun-carriage,

Tackle—Is thus described :—" A simple tackle consists of one or more pulleys rove with a single rope. The rope is termed a *fall*, and the pulleys are called *blocks* When a tackle is in use, one end of the fall is made fast, the other is hauled upon The fixed end is called the *standing end of the fall*, the other, the *running end* Each separate part of the fall contained between two blocks, or between either extremity and a block, is called a *return of the fall*

" To *overhaul* a tackle is to separate the blocks

" To *fleet* blocks is to bring them as close together as possible by hauling on the fall Wooden blocks are generally bound on the outside in the direction of their length, with a grummet, which is called the *strap* of the block

" If the strap be continued, so as to form a *tail*, at the end of the block which has no hook, the block is called a *tail*, or *jigger block*, and if a tackle has its movable block so furnished, it is called a *jigger tackle* A single movable block is called a *whip*, another single block applied to the fall converts it into a *whip upon whip* Two single blocks, one fixed and the other movable, make a *gun tackle* A single and a double block, the former fixed and the latter movable, make a *luff tackle*

" A treble and a double block, the former fixed, the latter movable, are called a *gyn tackle*

" A *runner tackle* is merely a luff tackle applied to the end of a large rope rove through a single block "

Tactical Points — Are thus defined by Colonel Macdougall "All points on a field of battle, which may impede the advance of an enemy to attack your position, or which may facilitate the advance of your army to

attack the enemy's position, are *tactical points*, and should be occupied"

"*Tactical decisive points*," he further explains, "are points on a field of battle which, when occupied by your army, will enable it to make an attack on the enemy whose success would be decisive on the issue of the engagement, and all points on a field of battle in possession of the enemy, which will enable him to frustrate your attack on any other part of his position, or which will enable him to impede or intercept your line of retreat, if repulsed, are *tactical decisive points for offence* Reverse the conditions, and you will obtain the tactical decisive points *for defence*

"The flanks and most advanced salients of the position are, in general, the most decisive points"

Tactics—By the word "tactics" is understood the art of moving troops and ranging them for battle Colonel Burne, in his Military Dictionary, defines tactics thus "Science of military movements made in presence of an enemy and within reach of his artillery The tactics of a soldier are the correct performance of military movements, those of an officer to know how to direct their execution, and those of a general to combine them in such a manner as to ensure success"

Under the head of Tactics is also included the different orders of battle, positions, attack, pursuit, and retreat,—all which points are treated of in the Aide Memoire to the Military Sciences, and the reader, if interested in the subject, will do well to read Colonel Macdougall's Theory of War, in which he will find some excellent maxims illustrating the subject of tactics

Tactics, Artillery—Teach the employment or practical use of artillery in the field, its organization for service, and its relation to other arms

Tail-board—The hind board of a store cart

Tambour — Is a small stockade, made in the shape of a redan or lunette, and placed in front of a long loop-holed wall, by which means a flanking defence is given to the wall An opening is made through the centre of the wall to give admittance into the *tambour*, to the entrance of which a stout door or barrier should be provided, and loop-holed to fire through, if forced

Tamping of Mines—As described in the Instruction in Military Engineering, 1870, "consists of filling up the gallery with solid material, for a certain distance from the chamber, with the view of preventing the force of the explosion expending itself in the gallery, rather than in the direction in which the mine is required to act The tamping should extend from the charge for a distance equal to at least one-and-a-half times the line of least resistance (or twice for a three-lined crater), and if the material used for forming the tamping be not heavy, or but loosely packed, this distance should be twice that line"

Tampion or Tompion—A wooden plug of the diameter of the bore of the ordnance it is intended to fit Tampions are placed in the muzzles of ordnance to exclude dirt and wet from the bore, but they are no preventive against moisture, unless they are covered with serge It is much better, therefore, if the precaution of binding them with serge is not taken, to leave the bores exposed to the circulation of the atmosphere The cylindrical portion of the tampions for rifled guns is covered with woollen serge, and strips of leather are provided to fill the grooves in the gun.

Tangent—In geometry, a straight line is said to be a tangent to a circle

when it meets the circumference in one point only

Tangent Block — In artillery, the block of metal in rear of the base ring of a gun, containing the tangent scale

Tangent Scale — *Vide* Scale, Tangent

Tap—A hardened steel screw with a square head, which can be turned by a wrench It is grooved from end to end, and is slightly tapered It is used for cutting an internal screw, as that of a nut, &c

Tappet Ring—Is the ring which is fitted on the octagonal part of the breech screw of an Armstrong gun, and is what the lever acts upon for working the breech screw Should it be removed for any purpose, care must be taken that it is returned to its seat in the same position it occupied at first, for if fixed in any other way the lever will not act on it in a proper manner A separate ring called the indicator, is placed in front of the tappet ring in the N P 40-Pr guns, and has an arrow cut upon it, which must correspond with a similar arrow cut on the gun to show that the vent piece is " home "

Taptoo or Tattoo—In military parlance, is the hour at which the day closes in, when all day duties cease, and night duties commence ,—this is 8 o'clock in the winter, and 9 in the summer

Tar—Is chiefly extracted from the roots of the fir, by a kind of distillation, a slow combustion of the tree taking place by certain means, as in making charcoal

Tare—In commerce, the weight or allowance made to the purchaser for the weight of the case, cask, or package containing the goods or articles purchased

Target—A mark to be fired at For gun practice, targets are made either of wood or canvas, if the practice is carried on landwards , if seawards, a floating target is provided The target for rifle practice is made of wrought-iron.

Tarpaulin—Canvas covered with tar for the protection of stores against wet and damp Not generally used on the Bengal side of India, waxed paulins having been substituted for them

Teak (*Tectona Grandis*)—This is the staple timber of India and Burmah, and the most useful and durable timber known, soon seasoning and easily worked The Malabar Teak is superior to that of Burmah in strength and durability Good teak is of a yellowish white colour, with reddish brown streaks, having close and straight grains A cubit foot of unseasoned wood weighs 55 to 60lbs It is extensively used in the Bombay Gun Carriage Agency

Teeth—This term is applied, in complex wheel work, to the teeth of cogs raised on the surfaces of wheels *Vide* Cogs

Telegraph, Signal — A machine by means of which intelligence is rapidly conveyed by signals from place to place The field telegraphs, though seldom used now, are composed of a mast and yard, from which latter, balls are suspended The vocabulary used is that of the Navy, many sentences peculiar to the Land Service being added These telegraphs readily communicate with each other at the distance of seven or eight miles. There is also what is termed an universal telegraph, consisting of an upright post of moderate height, having two movable arms fixed on the same pivot near the top of it, with a mark called the indicator on one side of it This tele-

graph is adapted to work night and day These telegraphs, though still used under certain circumstances, have been superseded by the Electric Telegraph, which is the universal means of communicating intelligence all over the world On field service advantage is taken of the electric telegraph to organize a system of telegraphy which places the general in command in momentary communication with all the divisions and detachments of his army *Vide* Military Telegraphy

Telemeter—An instrument for measuring distances Among the most beautiful hitherto produced may be mentioned the inventions of Cavallo, of Roch, of Professor Piazzi Smith, Astronomer Royal of Edinburgh, of Lieut -Colonel Clerk, R A , and of M Otto Struve, Astronomer Royal at St Petersburgh None of these, however, have been introduced into the service

M Otto Struve's instrument was some years ago introduced into the Russian service, and is now in use at Cronstadt

The latest and most approved telemeter is that of Lieut Nolan, R A , which was successfully tried at the Shrapnel *versus* Segment shell experiments, at Dartmoor, in 1869 For a description of this instrument, *vide* Royal United Service Institution Journal, No 57, Vol 14, 1870

Telescope—An optical instrument. By a proper arrangement of the lenses or glasses in a tube, objects at a great distance are brought near to the eye The invention of this invaluable instrument is ascribed to Roger Bacon or Baptista Porta

Tempering—In metallurgy, the preparing of steel or iron, so as to render it more compact, hard, and firm, or the reverse, more soft and pliant

Templet—A gauge to indicate the exact measurement of work to be done, and for ascertaining the size of various articles, such as wire, &c Templets are made of iron, steel, wood, or such material as is considered most suitable

Tenaille—In fortification, a low work in the main ditch before the curtain and between the flanks of the half bastions of a front of fortification It is usually 16 yards in thickness, and revetted with masonry all round

Tenon—In carpentry, the square end of a piece of wood or metal reduced to one-third of its thickness, which is inserted into a hole in another piece made to receive it, called the mortise, for the jointing or fastening of the two together, and a pin driven through to keep them in place

Tensile Strength—As applied to iron, is its power to resist being torn asunder by a force exerted by a breaking instrument in the direction of its length Cast-iron of good quality, such as is used in casting guns, ranges from 14,000 to 17,000 lbs on the square inch In experiments made in America, whenever the tensile strength of iron fell below 20,000 lbs the square inch, the quality was rejected and pronounced bad, and the gun unfit for service The capacity of cast-iron to resist compression is six times greater than its capacity to resist extension.

Tent—A covering for troops in the field Tents are of various sizes and descriptions, those used in India for the soldier being of a different size, shape, and weight to the tents used by British soldiers at home or in the colonies The Indian tent, as issued for the European soldiery, consists of a double fly or roof, and a single kanat or wall round it, it holds

12 men, but can contain 16 It is carried either on the backs of elephants or camels, or in country carts Non-commissioned officers are provided with a single-pole tent with double fly and single kanat Tents for Officers differ in size A Field Officer has a double-pole tent with two flies and two kanats, Captains and Subalterns have single-pole tents from 12 to 14 feet square, with double flies and double kanats Officers have to find their own tents

Terminal Velocity—Is thus described by Lieut-Col Owen "When a body descends in air from a state of rest, its velocity increases for a time by the action of gravity on it, but since the resistance of the air increases also while the velocity increases, it must at length become equal to the accelerative power of gravity, which is constant, after which the body will move uniformly with the velocity acquired at that time This is called the *terminal velocity* of the body"*

Terms, Military — Certain technical expressions, which officers of the army should be acquainted with, and which, directly or indirectly, ought to be used in writing on military matters, or in relating the events of a war

Terre-plein—Is that part of the rampart not occupied by and in rear of the guns, and is from 25 to 40 feet in breadth

Tertiate—To examine the thickness of metal in ordnance with callipers

The term "tertiating" is derived from the process originally adopted in measuring the three principal dimensions of a gun,—*viz* the calibre, the length of the bore, and the thickness of the metal at the breech

Tete-de-pont—A work covering the communication across a river Bousmard says, a tête-de-pont ought to unite the properties of a perfect defence of the river on both sides, to cover the bridge well, with space sufficient to contain the garrison, and to furnish a free passage for a considerable body of troops The tête-de-pont should also be sufficiently strong to resist an assault

Theatre of War—As explained by Colonel Macdougall, is the whole area of country in any part of which the hostile armies can come into collision with one another

Theodolite — According to Heather, is a surveying instrument which measures at the same time both the horizontal angles subtended by each two of the points observed with it, and the angles of the elevation of these points from the point of observation The theodolite, as at present constructed, consists chiefly of a pair of parallel plates, with adjusting screws, fitting on a tripod (similar in construction to the supports to the Y and other levels), a horizontal limb for measuring horizontal angles, and a vertical limb for measuring vertical angles

Thermometer—The following description is given in "Tomlinson's Cyclopædia of Useful Arts and Manufactures"—"There are three varieties of this instrument, differing merely in the notation Fahrenheit, whose thermometer is generally used in this country, fixed the zero of his scale at the temperature of a mixture of snow and salt, and divided the interval between this and the boiling point of water into two hundred and twelve equal parts or degrees, so that

* In strictness, a terminal velocity is never exactly attained, but in a short time from the commencement of the descent, the body acquires a velocity which is extremely near being uniform.

on this scale water freezes at 32°, and there are 180° between its freezing and boiling points Celsius, in constructing his modification of the thermometer, assumed as the zero of his scale the freezing point of water, and, proceeding on the decimal principle, divided the interval between this and the boiling point into one hundred equal parts, so that on this scale the point of ebullition is indicated by 100° Hence, his instrument, which is used extensively on the Continent, has been called the Centigrade In Reaumur's scale, as in the Centigrade, the freezing point is the zero; but the distance between the freezing and boiling points is in Reaumur's divided into 80 equal parts, instead of 100, so that on this scale the boiling point of water is at 80° In each of these thermometers the degrees of temperature under the zero are indicated by the sign *minus* Thus, — 15 Fahr indicates fifteen degrees of that scale below the temperature of a mixture of snow and salt, while the same notation on the Centigrade or Reaumur scale, signifies a temperature fifteen degrees of the one or the other of these scales below the freezing point of water

"By very simple formulæ, the degrees of any of these thermometers may be converted into the equivalent of the others The same distance is divided in the three thermometers into 180° in Fahrenheit's, 80° in Reaumur's, and 100° in the Centigrade Now, dividing by twenty, it will be seen that these numbers are in the ratio of 9 4 5, or, in other words, nine degrees of Fahrenheit's scale are equivalent to four degrees of Reaumur's and five of the Centigrade Hence indicating the respective thermometers by the initials F, R, C, the length of a degree in each will be as follows —

$$1^\circ F \quad 1^\circ R \quad 1^\circ C \qquad \tfrac{1}{9} \quad \tfrac{1}{4} \quad \tfrac{1}{5}$$

But the temperature is measured by the number of divisions contained in equal portions of the stem of the respective thermometers Now, the zero point of Fahrenheit's is 32° below freezing point If, therefore, $F^\circ - 32$, R°, C°, indicate the same temperature on each of the three thermometers, one has the proportion $F^\circ - 32 \quad C^\circ \quad R^\circ \quad 9 \quad 5 \quad 4$, whence result the following equations for converting one scale into another —

$$4\,(F^\circ - 32) = 9\,R^\circ$$
$$5\,(F^\circ - 32) = 9\,C^\circ$$
$$5\,R^\circ = 4\,C^\circ$$

or,

$$\tfrac{1}{9}\,(F^\circ - 32) = \tfrac{1}{4}\,R^\circ = \tfrac{1}{5}\,C^\circ$$

"The divisions principally used are those of Fahrenheit and the Centigrade, and the equations for passing from the indications of the Centigrade to those of Fahrenheit, and *vice versâ*, are—

$$F^\circ = 32 + \tfrac{9}{5}\,C^\circ$$
$$C^\circ = \tfrac{5}{9}\,(F^\circ - 32)$$

— that is, add thirty-two to nine-fifths of the number indicated on the Centigrade, and the result is the number which would be indicated by Fahrenheit, subtract thirty-two from the number indicated by Fahrenheit, and five-ninths of the remainder is the number which would be indicated by the Centigrade

"When very low temperatures, under — 40° Fahr, have to be estimated, a mercurial thermometer cannot be employed, since this metal solidifies at that point, in such cases, alcohol colored by some matter is used in the bulb of the instrument On the other hand, mercury boils at about 600° Fahr, and, therefore, when very high temperatures are to be estimated, a

different instrument, termed the pyrometer, is employed

"Whatever be the form of thermometer, it is evident that the indications are merely relative, and do not express the actual amount of caloric which a substance contains The use of the thermometer, therefore, is merely to indicate the sensible heat, or that which is capable of being radiated or communicated from one material to another, and for this purpose it is of most important application in various branches of the arts and manufactures, serving for the guidance of the operative in numerous processes, to the success of which it is absolutely indispensable"

Thimble—The iron ring attached to the end of drag-ropes, siege and field The thimble is firmly secured in its place by a spliced eye of rope surrounding its outer circumference

Thorough-pin—In a horse, is the enlargement between the flexor of the foot and the extensor of the back It is the result of over-work, but hardly constitutes unsoundness in a horse It should be treated as for windgalls

Thread, Cotton—Is made up in skeins of single threads weighing about two ounces each It is used in arsenals and magazines for quickmatch, and in a twisted state by sailmakers for sewing

Thread, Worsted—This article is used in forming the cups of quill tubes Twelve ounces will be sufficient for about 1,000 cups

Throttle-valve — A valve in the steam pipe of an engine for regulating the supply of steam to the cylinder In land engines, it is generally connected to the governor

Thrush—A foul discharge issuing from the cleft of a horse's frog, and attended with disorganization of the horn. It is derived from two causes, either internal disease or bad stable management Apply astringent ointments for its cure

Thumb Screw — A pressure screw, an adjusting screw.

Thumb Stall—In artillery, is used by the gunner who serves the vent, to protect his thumb

Tie-Beam—In a roof, is the beam which runs across the breadth of the building, the ends resting on the side walls of the house Two sloping rafters called *principals* are mortised into the tie-beam at their ends by a joint, and to prevent the principal from starting upwards out of the mortise, it is strapped down to the tie-beam by iron straps, bolted or screwed to both timbers.

Tier Shot—*Vide* Grape

Tilt — An awning or covering placed over a store cart

Timber—Wood used for building and other purposes For a description of the woods of India, the reader is referred to Dr Balfour's Encyclopædia of India, for the timbers of Southern India, to Dr Cleghorn's Work, for information of the trees of the North-West of India, and to General Cunningham's pamphlet on the Timber in the Gwalior Territory There is also an admirable little work published by Conductor Skinner of the Gun-carriage Manufactory at Madras, entitled "Indian and Burman Timbers"

The timber used in the manufacture of gun-carriages in Madras and Bombay is obtained from the different localities shown in the annexed statement

Bengal almost exclusively uses Saul and Sissoo, which are procured from forests in Oude. If Sissoo could be procured in abundance, it would be the best wood for all parts of a gun-carriage

The carriage of the new field gun for India is made of iron, which will reduce the demand for timber, which hitherto has been very great

Timber Hitch—*Vide* Hitch

Time—A measure of duration Mean or civil time is divided into years, months, weeks, days, hours, minutes, and seconds For additional particulars on Time, *vide* Day

Time of Flight—In gunnery, the time a projectile takes in describing *any portion* of the trajectory, reckoned from the moment of discharge, or the whole range

Tin—Is a white metal approaching silver in lustre It is found in great abundance in Cornwall and in parts of Europe, in Chili and Mexico, in the Peninsula of Malacca, and in the Island of Banca It is very malleable , it fuzes at 442° Fahr, and contracts slightly on consolidation Its density varies from 7 29 to 7 6, the lightest being the purest metal It is used as an alloy with copper for forming gun-metal *Vide* Block Tin

Tin, Sheet—Is made by coating iron with tin The iron is first scoured or thoroughly cleaned by means of an acid, and then immersed in melted tin There are two kinds, single and double tin, differing in thickness and in the quantity of tin with which the iron is coated

Tirailleur — A sharp-shooter , skirmisher , one who shoots at random Tirailleurs are likewise riflemen and marksmen, used sometimes in front of the army to annoy the enemy, sometimes in rear to check his pursuit It appears that tirailleurs were first employed in the American army

Tire, or Tyre—An iron band which encircles a carriage or cart-wheel There are two kinds of tires, *viz*, the "ring-tire" and "streak-tire," the former, which is simply a band of iron fastened on without any break, has been universally used in the artillery service in India In the home service, until very lately, the streak-tire, which is fastened upon the wheel in pieces, and not in one continued ring, has been the pattern adhered to, but the ring-tire is now ordered for all wheels not exceeding three inches in breadth The breadth of field carriage tires is three inches, and half an inch thick, that of siege carriages, six inches, and half an inch thick

The following method of re-tiring wheels may be found useful —

The first step is to remove the tire

Lay the wheel face down on the ground, and measure roughly with the beam compasses the various felloes, selecting the longest and marking the end from which it will prove most advisable to cut off a piece This will probably be that end which has the greatest space between the spokes Cut the tire at the bolt hole between the two ends of the felloe selected, having first removed all the bolts, but previous to cutting the tire, it is necessary to put chisel marks I, II, III, IV, and so on, first on the tire and adjoining felloe, at a point diametrically opposite to where it is intended to cut the tire, and next, on the nave and nave box, also at points diametrically opposite the point of cutting The tire may now be cut Many smiths prefer cutting it through with a cold chisel The best plan to adopt is to nick the edge of the tire pretty deeply, say ½ or ⅜ inch, with a chisel held upright, and with its edge in a radial line with the wheel , then turn over the wheel and nick the same portion of the tire on the other side, then, having placed the wheel with its tire and felloes on a

couple of anvils, the opposite side being a little raised to ensure contact between the tire and anvils and not between the felloe and anvils, strike three or four heavy blows on the tire, first on one side, and then, after turning over the wheel, on the other side, and the tire will break across

Should the spokes be loose in the nave, remove them, and bind a strip of canvas over the spoke end which enters the nave, and then drive them home, this will make all tight If desirable, use canvas painted with red lead paint, or vitry will perhaps be thick enough But before driving the spokes home, be careful to tighten the nave-bands if requisite, this may be done without cutting the bands, by smart smiths, of course the nave-box is supposed to have been removed It may be necessary to put two strips of canvas or vitry over the spoke ends, one to remove looseness as regards the breadth of the spoke, the other as regards its thickness, but avoid excess in this last, as it tends to split the nave

Now put on the felloes, supply fresh wedges, and see that the dowel pins are not too long, especially where it is intended to cut the felloe, and cut out by guess what will be rather over what is required to permit the felloes closing up to the spokes at the shoulders of the tenons or their outer ends When the felloes are close up, see what amount of open space or joints there is in the entire circumference, and if light delicate tiring is required, make up the aggregate of these open joints to ⅝ inch in a 5-foot wheel, and proportionally in other wheels If the wheel is very old, and canvas has been used, allow ½ an inch for delicate tiring—never mind how these open joints are "spaced" they are better pretty equally distributed all round the wheel Now take the perambulator wheel, which is made of wood and is a trifle under 8″ diameter so that one revolution just runs the length of a 2-foot rule, and placing a chalk mark on a felloe or a joint, and with the wheel face upward, measure from that mark round the wheel to the mark again, keeping the wheel turning round just in the same direction as the hands of a clock, or yourself moving it continuously round to your right hand, and taking care that you avoid the hollows at spoke ends You have thus the outer circumference of the *wheel*, and setting that mark *back* by the quantity of your open joints and by ⅜ inch extra for pinch of tire, you have the true inside measurement of your *tire*, when ready for fitting on the wheel

Suppose the tire cut, and not yet welded, allow an excess of length of ¼ inch for the quantity necessary for the scarf and burning of the metal in welding Make the scarf as short as possible, ¾ inch is the very utmost that should ever be allowed in a field tire When welding broad tires, cant the tire This permits the blast to heat the whole scarf instead of burning the edge only Insist on short scarfs, and use a *little* sand in welding Punch and countersink the hole for the tire bolt at the weld, a grape shot may be used instead of a countersink, striking it with a hammer Heat the tire all together, placing say No 5 lowest, then 4, and so on, the nicks upwards, and all towards the same compass point, the wheel being similarly arranged Use two large watering-cans with flat nozzles instead of the usual circular garden nozzles, and fill them with water The removal of the tire from the fire is often a scene of hurry and confusion, for the heat is great

To prevent this, cool smartly the *outside* of the cow-dung fire by using your two watering-cans The smiths can then without hurry remove the tire and put it on the wheel When on, at once use the cans, or have three or four in use, and bheesties ready to fill them from a reservoir But before putting on the tire, use all the water-cans, to reduce it to a dull red heat, and to bring at the same time any excessive heat of parts to uniformity, also, before tiring, screw down the nave to prevent any increase of dish

Toat—The handle of a plane

Tobrah—An Indian term for a horse's nose-bag

Toggel or Toggle—A belaying pin A small piece of wood fastened to the end of a string or lanyard serving as a hold to grip by

Toise—The French measure of 6 feet, or 6 395 English feet

Tonnage—By this is understood the amount of space which stores take up on board ship, and is calculated by weight, in cubic contents—a ton consisting of 40 cubic feet, but metals and very heavy articles are estimated by actual weight without reference to bulk

Tools—Are instruments employed to facilitate the various operations which have to be carried on by hand or by machinery either in wood or metal work

Toothing Plane—A scraping plane, with a perpendicular iron, which is grooved on the face to present a series of fine teeth instead of a continuous edge It is used generally by the cabinet-maker for roughing and scratching veneers, and the surfaces to which they are to be attached to make a tooth for the better hold of the glue

Topographical Survey—A branch of the Surveyor General's Department in India, to which is allotted jungly and mountainous districts which are not considered of sufficient importance, from a revenue point of view, to survey on a large scale The work of this branch is based on a system of triangulation, and the details filled in by plane tabling The usual scale is 1 inch to the mile

Topography — A minute and particular description of the soil and surface of any country

Torpedo, Electric—This terrible and deadly weapon of warfare is used as a means of defence against the approach of an enemy by sea By the aid of electricity, this mode of defence may be said to render our rivers unapproachable to an enemy's fleet, and even in the deep sea, when skilfully placed, to be a source of imminent danger to the strongest ironclad

During the American war in 1864, the value and importance of electric torpedos were fully realized, and taken advantage of by the Confederates

It is related by Mr Holmes, C E, in a lecture at the Royal Institution, in 1866, that, in 1864, the Federal fleet passed up the James River, the channel way of which was entrusted to a single torpedo, placed in mid-channel, and which it was arranged was to be ignited by electric agency, and to be exploded even to the precise second of time required To use the words of Mr Holmes —

"Few illustrations can be more instructive to show the value of the electric torpedo, and the deadly nature of its effects, than the narrative of the springing of this mine

"The officer in charge was concealed a few yards from the edge of the river-bank, sufficiently near to distinguish the voices of the officers and crew upon

the deck of the steamer, the advancing vessel of the fleet, carrying five guns and 120 men

"By previous arrangement it was determined to reserve this mine for the admiral's ship, the steamer was therefore allowed to pass up the stream unharmed, in advance of the admiral The officer in charge of the mine, hearing, however, the order given to fall back and send out the boats to drag for torpedos, determined to hoist her as she passed down to rejoin the fleet

"The explosion took place on a clear afternoon, and was witnessed by many persons The boilers, engines, and smoke stack went up about 20 or 30 feet, the boilers bursting at the same time, and the hull of the vessel was shattered to fragments

"Strange to say, three of her people escaped alive"

The subject of torpedo defence ranges over a greater space than this work will permit, but the reader, if he desires, will be repaid by a perusal of Mr Holmes' lecture in the Royal Institution papers of May 1866

The torpedo, in its complete form, consists of three parts the fuze, the charge, and the torpedo case or tank, together with the necessary interval and external arrangement of electric connection and conduction, giving the operator the entire control over the mine The fuze that is used, and best fulfils the required conditions, appears to be Abel's electric fuze, and from experiments carried on at Chatham, compressed gun cotton is likely to form the charge for torpedoes

In a lecture delivered at the Royal Institution, Whitehall, in June 1870, by Colonel A à Court Fraser, C B, R E, after discussing the subject of gun-cotton for torpedoes, remarks as follows "There is another point that is important. A charge of gun-cotton calculated to do the same work as a given charge of gunpowder would occupy only one-fourth to two fifths of the space, the cost of the torpedo, therefore, would be reduced in proportion, as also the labour in handling, fixing, or mooring it, also the space required for storing torpedoes Again, if it were required to employ 'buoyant' torpedoes, the amount of buoyancy, or buoy power, required to keep them in place, would similarly favour the employment of the gun-cotton charge"

Torsion or Twisting — Is seen in the force exhibited by a weight attached to a silken thread or wire, which is made to revolve several times in the same direction, whereby the silk becomes twisted, and is then disengaged, the fibre of the silk in virtue of its elasticity untwining itself, and causing the weight to revolve in a contrary direction, the process of untwining continuing until the filament recovers its original position

Touch-Hole — The primitive name for the vent of a gun

Tour of Duty—Duty in succession As defined in the Queen's Regulations, "the tour of duty is to be from the senior downwards

"The 1st is the guard of the Sovereign,

"2nd, Those of the Royal Family,

"3rd, Those of the Captain General or Field Marshal commanding the army,

"4th, Detachments, or out-posts,

"5th, General Officers' guards,

"6th, Ordinary guards in camp or garrison,

"7th, Piquets,

"8th, General and garrison courts-martial, and duties without arms, or of fatigue

"Officers on the inlying piquet are

liable to be relieved, and to be employed on other duties

"If an officer's tour of duty happen when he is on the inlying piquet, he is immediately to be relieved, and to go upon that duty, and his tour upon piquet is to pass him

"If an officer's tour of duty for piquet, general or garrison court-martial, or fatigue, happen when he is upon any other duty, he is not to make good that piquet, court-martial, or duty of fatigue, when he comes off, but his tour is to pass, and in the like manner, if he shall be upon a general or garrison court-martial, or duty of fatigue, and his tour of guard or detachment shall happen, such guard or detachment is to pass him, and he is not to be obliged to make it good

"When, from peculiar circumstances, it is probable that a considerable time may elapse before the sentence of a court-martial be made known, the members are liable to return to, and do duty with, their respective corps, at the discretion of the General officer commanding, but they are on no account to quit the station where the court-martial is held, without special authority, until the sentence shall have been approved and confirmed

"A court-martial, the members of which shall have been assembled and sworn, is to be reckoned a duty, though they shall have been dismissed without trying any person

"When an officer is warned in orders for one duty, he is not to be placed on any other duty without authority

"An officer is not to exchange his duty with another, without leave of the commanding officer of his regiment, or other authority by which he was placed on that duty.

"A regiment, detachment, guard, piquet, or fatigue-party is not entitled to exemption from a tour of duty, unless it has marched off the ground where it may have been ordered to parade"

Tournament—A military exercise which took its origin from the ancient gladiatory combats, which had for their objects the training of the youth of the day in all exercises tending to make them active, athletic, and expert in the art of war This led to those encounters termed *jousts*, in which a couple of knights met each other to test their prowess and gallantry, being clad in armour and using weapons of warfare, such as the sword and lance, as their arms On this followed the tournament, a gathering held for the purpose of bringing together a number of knights who should have the opportunity of exhibiting before this assembly their deeds of valour In such encounters, as were held under the name of tournaments, in the middle ages, life was not unfrequently sacrificed, but the knight who slew or disabled his adversary was indemnified against all consequences In later times, to make the tournament more a field for deeds of strength and prowess than for deadly combat, two sorts of arms were employed, those expressly made for the purpose,—*viz*, lances with blunt heads of iron, and the ordinary arms of warfare with which knights had the opportunity, if permitted, of signalising themselves in more than ordinary degree Every knight attending was required to show noble birth, or rank, as a title to admission These were at first proclaimed by the heralds with sound of trumpet, and hence the word *Blazonry* (which signifies the correct deciphering of the heraldic symbols on a coat-of-arms,) derived by some from the German blasen, *to blow* Afterwards, when armorial bearings be-

came general, the shield of the knight gave token of his rank and family

As time went on, and in succeeding centuries, tournaments were graced by the presence of ladies, who distributed the prizes to those knights whose bearing in the encounter stamped them as worthy of recognition, and we find still later on, in the reigns of Edward III and Henry V, that the jousts or tournaments were generally held in honor of ladies, every knight being bound to possess, in reality, or in show, a dame of his affections, for whose sake all these deeds of chivalry were performed

Tourniquet — In surgery, a bandage which can be tightened or compressed to any extent It is chiefly used to stop hœmorrhage in cases of amputation, and is invaluable on the field of battle

Tow—Flax or hemp ready for spinning

Tower—A movable engine used in ancient sieges, and of such a height as to place the besiegers, by being thus raised, on a more equal footing with the besieged

Trace—In fortification, to mark out on the ground the dimensions of a work

Traces — Form a very essential part of harness, and are indispensable to the draught They consist of lead and wheel, long and short traces, and are made of white rope, encased in a leather covering or pipe, having a trace-hook and trace links at either end

Track of Artillery Carriages — Is the breadth contained between the two wheels of a carriage, measuring from the outer rim of each wheel It is ordered that the track of field artillery carriage wheels, in future manufacture, is to be 5 feet 2 inches from outside to outside of the tire

Traction—*Vide* Angle of Traction

Trail—The beam of a field carriage extending from the rear of the brackets to the end of the beam, and which, when unlimbered, rests on the ground at an angle of about 21°, and when limbered up attaches the limber to the gun-carriage The beam of a gun-carriage is either made out of one block, or of two pieces of timber tabled together, under either circumstances it is termed a block-trail carriage The trail of a siege bracket carriage is the extremities of the cheeks which rest on the ground

Since the introduction of the 9-Pr M L rifled gun for India, the trail has been changed from a block to a bracket trail made of iron

Trail-Plate — The iron work attached to the end of the trail which includes the trail-plate eye This eye or loop is fixed in the R P carriages, and forms a part of the trail-plate Swivel loops have been used in the Madras carriages, and they are said to have this advantage, that if the gun-carriage upset, it does not entail the fall of the limber

Train—In a military sense implies the ordnance, carriages, ammunition, and in fact all the apparatus and implements of war which are required at a siege,—hence the term *siege train*

The term is also used in mining to express the powder laid by the miner for some distance along the ground, up to the charge, and by which means the charge is ignited

Train Bands—A body of men which formerly constituted the militia of London, and out of which the 3rd Buffs were raised

Trajectory — Is the path described by a projectile in the air or in vacuo. The curve described in passing

through the atmosphere is due to three forces,—the force of projection, gravity, and the resistance of the air

Transit—In astronomy, the passage of any heavenly body over a larger one, as Mercury or Venus over the Sun

Transit Instrument—Is an instrument for observing the *time* of passage of a celestial object across the meridian It consists of a telescope attached to a transverse horizontal axis, the ends of which are directed to the East and West points of the horizon

Transom—A stout piece of timber or beam connecting two corresponding parts of a carriage Siege carriages hitherto formed of two brackets, are connected together by three transoms, but the length of the transoms, which regulates the width of the carriage, varies according to the nature of the gun

Transports—Vessels taken up by Government for the conveyance of troops The approximate amount of tonnage required for the transport of troops is about 270 tons to every 100 men *Vide* Queen's Regulations for the Rules and Regulations attending the transport of troops The room given, and the precautions to be taken in the transport of horses, will be found in the proceedings of the R A Institution papers Nos 1 and 6 of 1868 Since the first edition of this work, the Indian Government has built a fleet of large steam vessels for carrying out the relief of the European troops between England and India, capable of containing a couple of regiments or upwards The port of embarkation and debarkation in India is Bombay

Trapezium — A quadrilateral figure, whose sides are unequal, and none of which are parallel

Trapezoid—Differs from a trapezium, inasmuch as two of its sides are parallel

Traverse—In gunnery, a term applied in laying a piece of ordnance, whenever it is necessary to point the muzzle either to the right or left of the position it is in In smooth-bore pieces, mounted on carriages, traversing takes place from the trail With mortars it is performed by hand-spikes in rear and front of the bed The Armstrong gun has an adjusting wheel screw which enables the pointer to traverse the gun with his own hand and with the greatest accuracy

Traverses—In fortification, are portions of parapet thrown across the covered way on the prolongations of the faces of bastions and ravelins, and at the entrance of the re-entering place of arms, passages or crochets are cut into the glacis, to enable the defender to circulate round the traverses

Traversing Hand-spike—In field carriages, is attached to the end of the trail, it is movable, and when the gun is not in action, is packed away into its place, being strapped on the surface of the trail There is also a spare hand-spike carried underneath the trail The trail handle attached to the new field gun for India is made of iron, T shaped, and fixed to the trail in such a manner that it can be laid flat on it when not required, without being unshipped It was the handle in use with the late Indian Artillery Batteries

Traversing Platform—*Vide* Platform

Treadle—As described in Weale's Series, a lever or frame connected by a rod to the crank of a foot lathe, to give motion to the crank shaft, it is pressed down by the left foot of the turner, and raised by the centrifugal

force of the fly-wheel or large pulley which is fixed on the shaft

Trench Cart — *Vide* Cart, Trench

Trenches — In offensive works and batteries, it is necessary on many occasions to throw up a parapet, from earth excavated in rear of the parapet, such an excavation is termed a *trench* The usual depth of trenches is 3 feet Should the nature of the ground be such as not to yield sufficient earth for the parapet, a small ditch must be made in front In a siege, the approaches made by the besiegers are termed trenches, which are usually opened at about 600 yards from the place To open the trenches is to "break ground" for the purpose of carrying on approaches towards a besieged place

Trestle—A piece of timber or metal supported at each end by legs

Tret—Is an allowance of 4lbs in every 104lbs weight of goods, to compensate for dust or any foreign matter which may intrude itself into the goods

Triangles — An instrument used at one time in the army for the purpose of tying soldiers to when sentenced to receive corporal punishment It consisted of three poles fastened together at the top, and which were susceptible of having the legs stretched out in the shape of a triangle In each leg there was a spike which kept it firm on the ground, an iron bar, breast high, was fastened across one side of the triangle

Trigonometrical Survey—Is thus described in Brande and Cox's Dictionary —"When a survey is to be effected on a large scale, as for making a geometrical map of a country, or for measuring an arc of the terrestrial meridian, not only is minute accuracy required in all the practical parts of the operation, but it becomes necessary to have regard to the curvature of the earth's surface, the effects of temperature, refraction, altitude above the sea, and a host of circumstances of which the influence is wholly unappreciable in the practice of ordinary surveying" In India, the trigonometrical survey has been carried on, for many years past, under the most able men of the Indian, now Royal Engineers, and from the extent of the country, their operations are likely to continue for a lengthened period For a detailed description of the mode of carrying on a trigonometrical survey, the reader is referred to the above-quoted work

Trigonometry — The art of measuring triangles, or of calculating the unknown sides of any triangle It is either plane or spherical

Tringle—A riband or piece of wood nailed on the sides of a traversing platform, to prevent the trucks from running off in the recoil

Trituration — Pulverising the ingredients of gunpowder *Vide* Mix

Tropic of Cancer—Is a small circle 23½° north of the Equator and parallel to it.

Tropic of Capricorn — As described in Milner's Descriptive Atlas, is a small circle 23½° south of the Equator and parallel to it The tropics on the terrestrial sphere divide the Torrid from the two Temperate Zones, and the Polar Circles, each of which are 66½° from the Equator, divide the Temperate from the two Frigid Zones Twice in the year the sun is vertical to those who dwell in the Torrid Zone, consequently at noon they deflect no shadow At other times their shadows fall at noon, north or south, according as the sun is north or south of them Those who dwell in the Temperate

Zones have their shadows at noon always cast one way,—towards the north in the North Temperate Zone, and towards the south in the South Temperate Zone

Trot—The next pace of a horse after the walk It is about seven miles an hour

Trough for Hale's Rockets—This machine is adapted for firing all natures of Hale's rockets It is made of plate-iron, and is supported on two short legs in rear and a tripod in front There is an arrangement at the rear end of the trough by which the rockets may be fired with the friction tube and lanyard

The elevation has to be obtained by moving the legs closer or farther apart as required

Trous-de-loup—Or trap-holes, are rows of pits in the form of inverted cones or pyramids made before a work, and having a strong palisade or stake in the centre of each To prevent the enemy's riflemen from making use of them, they should be made either too deep or too shallow,—that is either 8 feet or 2½ feet deep

Truce—A suspension of hostilities for the purpose either of parleying, burying the dead after a battle, or any other purpose thought fit by the Commanders of the opposing forces Such a truce may be termed partial or temporary A truce, or general armistice, for the termination of hostilities, or for the purpose of carrying out some important object in which both sides are interested,—such as the armistice offered by Prussia to France for 25 days to carry out the election of the constituent assemblies, but which was refused by France,—requires the ratification of the sovereign power, or generals having full power to execute Persons bearing a flag of truce from the enemy, are, in the terms of the Queen's Regulations, to be treated with attention and civility, but as communications of that nature are frequently designed for the purpose of gaining intelligence and of reconnoitring the army and its outposts, the most strict and efficacious means are to be adopted to frustrate such intentions

Truck Carriage—An inferior kind of platform wagon It is used for carrying ordnance and heavy boxes for short distances, for taking guns through the passages or sally-ports in which there are no short turnings There are three sizes of truck carriages,—large, medium, and small Guns are mounted on them, and lashed in the same manner as on sledges

Trucks—Small iron wheels attached to garrison standing carriages, wooden ones to ship carriages

Trumpet—A wind instrument, made usually of brass, and used by the Cavalry and Artillery for sounding the various calls of these Regiments

Truncated Cone—The frustrum of a cone, the top of which is cut off by a plane parallel to its base

Trunnion Holes—A cavity made in the upper part of the gun-carriage brackets to receive the trunnions Siege carriages have travelling trunnion holes as well as firing holes

Trunnion Rule—As described in Simpson's Naval Gunnery, is used for measuring the distances of the trunnions from the rear of the base ring It is a long graduated rule, having on it a piece of metal in the shape of an L, one leg of which rests on the top of the trunnion, while the other rests against its side, and the distance of the trunnion from the base ring is read off from the staff This instrument is used in the U S. Artillery

Trunnion Sight, Armstrong Gun — This sight, which is used with the 40-Pr (old pattern), 20-Pr, 12-Pr, and 6-Pr, is made of steel in one piece, and is screwed into the sides of the trunnion pieces In the 40-Pr (new pattern) and 9-Pr guns, the trunnion sights are made of gun-metal studs, slipped and locked into sockets fitted in the guns for their reception and the top of the studs are not finished until after they are fixed on the gun The finishing of the sights is then done by means of the sighting instruments

The solid steel trunnion sights are fixed or removed by the double ended spanner of the smith's tools The trunnion sights of the new 40-Pr and 9-Pr guns can be removed or fixed at a moment's notice by simply raising the brass collar, giving the sight a quarter turn from left to right to release the stop from the recess in the bottom of the socket, and lifting it out, the sights can be replaced by reversing the operation

Trunnion Square — An instrument used for ascertaining the position of the trunnions in relation to the axis of the bore It has a movable wrench and sliding point

Trunnioning Machine—A turning lathe in which the trunnions for ordnance are turned The piece is secured in the turning lathe by two centres which are made to press against the extremities of the trunnions, and while a rotatory motion is communicated to the gun about the axis of these trunnions, they are turned by cutters pressed against them

Trunnions—Are two solid cylindrical pieces of metal by which the gun is supported on its carriage in the trunnion holes, and on which it moves as on an axis, so as to admit of any required elevation being given to it Trunnions are cast sometimes with their axis a little below the axis of the piece, and at right angles to it, and sometimes with their axis in the same plane with that of the piece They should be of equal diameter, and about one calibre in diameter and length Many of the smooth-bore pieces in the service, except howitzers, have the axis of the trunnions below that of the piece, but in all guns made at the present day, it passes through the axis of the piece

Trussing—In carpentry, is the mode of strengthening any beam which is long in porportion to its breadth and thickness, and which is incapable of supporting much additional load It is a mode adopted in strengthening the girder for floors

Tube, Electric — The invention of Mr Abel, Chemical Examiner to the War Office This tube is used for firing guns at proof, and has superseded the galvanic tube for this purpose It can be used for firing a large number of guns simultaneously It is also used for firing the time guns at large stations by means of an ordinary telegraph wire from whatever observatory the electric battery may be placed in This tube can be fired by means of any electric agency, but is especially intended to be fired by means of an electro-magnetic apparatus, or "magnetic exploder"

Tubes — In the artillery service, are used for discharging ordnance There are several natures of tubes, the most common being the friction tube made of copper,—but there are friction tubes made of quills with loops for the service of the navy

Tucked-up—A term given to a horse out of condition, and whose flesh has shrunk away from his flanks

Tugs—Straps used in shaft harness for keeping up the shafts

Tullub—An Indian term signifying a demand, but it is commonly used amongst the natives of India when speaking of their monthly pay

Tumbler—One of the limbs of a musket lock

Tumbrils — Are covered carts, and are used for a variety of military purposes

Turn-table — A circular plate of metal carrying rails of the same gauge and on the same level as the adjoining rails The plate is movable on a central pivot, supported underneath, at different intervals, and near the circumference, by small wheels It is placed at the crossing of one or more lines of rail, and on the engine or carriage being placed upon it, the plate is moved round in the direction required

Turner—A mechanic whose business is to shape wood, metal, and other hard substances into round or oval figures, by means of a machine called a lathe In turning, the work is usually put into the lathe, and made to revolve with a circular motion about a fixed line or axis, it is worked to the intended form by means of edge-tools presented to it, and held down upon a fixed rest The projecting parts of the work are thus brought up against the cutting edge, and are cut off, whereby the outer surface is so reduced as to be at an equal distance from the axis of motion, and thus it presents a circular figure If the axis be made movable during the revolution of the work, we may have oval and rose engine turning

Turning Ordnance—This is accomplished at the time the piece is being bored (*vide* Boring Machine), cutting instruments being applied to the exterior of the gun, which is turned down to the proper size That portion of the gun situated between the trunnions cannot be so removed, it is therefore taken off in a planing machine, in which the piece moves backward and forward under the cutter Such portions of the surface as cannot be reached by these two machines are removed by the chisel

Turpentine—(*Vide* Spirits of Turpentine)

Tutenag—An alloy of 8 parts copper, 3 of nickel, and 6½ of zinc It is a very hard, fusible alloy, not easily rolled, and is best adapted for casting It sometimes contains a small proportion of iron

Tuyere—A blast pipe

Twist—Is the spiral turn given to the grooves of a rifled gun round the inner surface of the barrel

U.

Uhlan — This is said to be a Polish word The name will be familiar to all who have read the accounts of the late continental war describing the value of the light horsemen attached to the Prussian Army

The following account of the use of these troops will, doubtless, be interesting —

" Stripped of all mystery, the Uhlan is merely a light horseman, whom the astute Prussian generals employ as cavalry ought to be employed They have well-nigh abandoned to the French commanders the fatal custom of launching horse-soldiers against infantry The utter destruction of the French Cuirassier regiments, which charged in the face of the needle gun, and the shrapnel batteries at Woerth, has shown what must, for the future, be the fate of heavy cavalry when

matched against foot soldiers armed with the breech-loader and supported by artillery The Germans, it is true, have also their ponderous squadrons of horse, which they have once or twice flung against the French line, only to waste noble stuff, but the major part of their splendid cavalry is *light*, and *it is so numerous that* it can be used to mask all their own movements, and, like a swarm of spies, to search the country of the enemy, to gather information from all quarters, to facilitate, and often to render unnecessary, an armed attack; and to bewilder, while harassing, the foe Heavy cavalry is still proved most useful in warfare in order to break a wavering front, to complete a repulse, or to secure all its fruits But the Prussians have been the first to carry out to its full extent that employment of light cavalry which had been urgently recommended by General Trochu, by General Sherman, and many other masters of modern warfare In the American conflict, Lee rushed on his ruin at Gettysburgh for lack of using his Southern Uhlans, while Sheridan, by dexterously employing those of the Northern flag, took the Petersburgh defences General Sheridan, who is now with the Prussian Army, must be wonderfully interested to see how Sherman's example, with his renowned 'raiders,' has been developed by the *eclaireurs* of the Crown Prince Nelson called his frigate the 'eyes of his fleet,' but the Uhlans are eyes, ears, and hands all in one, for, besides picking up information from every point of the compass, they have, by sheer audacity and the prestige of their ubiquity, also picked up towns and villages for the main army in their rear. It would be more accurate, perhaps, to call them the *antennæ* of the host, for they at once inform and shield the mass which sends them forth Put out just like 'feelers' in every direction, they make a ring of mystery round their own army, the enemy does not know where to have it, while they carry back ample and *constant information to their chiefs* The French have utterly failed in respect of their intelligence department, they were outwitted at Wissemburg and at Forbach, and we cannot wonder when we read such a statement as that subjoined from a letter dated at Rethel on the 25th 'I was surprised last night at the facility with which I rode through the French lines at dead of night I did not hear a single 'qui vive,' and don't think I saw a single sentry' France has forgotten many lessons of the First Napoleon, and amongst them his keenness to obtain information in the field"

Ultimatum—In diplomacy, the final condition offered by one Government or its representative, for the settlement of its disputes with another, or, in the case of any unusual disturbance or loss experienced by friendly subjects from the riotous conduct of the inhabitants of a country Also a demand made for reparation, which, if not acceded to within a certain time, necessitates the withdrawal of the ambassador, and a state of war ensues

Unattached List—This term has reference chiefly to the Army in India, where the services of soldiers in the ranks are occasionally transferred from regimental to staff employ, and placed on a separate list, which removes them altogether from their regiments If for any reason a soldier returns to his regiment, he resumes the rank he originally held in it, unless

he has been reduced to the ranks by sentence of a Court Martial All men attached to the Ordnance or Commissariat Departments are placed on the unattached list.

Uncap — This term is used in taking off the cap of a fuze In Boxer's fuze, the cap is made of sheet tin Underneath the cap is a small disc of card-board, to which a piece of tape is attached, this tape is allowed, when the cap is put on, to hang outside the fuze, having a knot at the end When the fuze is required to be used, the tape is taken hold of, and with a slight jerk, the cap is freed from it

Under-arms — Troops are said to be under-arms when assembled on parade, fully armed and accoutred

Uniform —The dress of an officer or soldier on parade or on duty It appears that, however ancient the custom of clothing in some distinguishing manner the soldiers of nations is allowed to be, it is impossible to trace the first adoption of military uniform beyond the 11th century

During the crusades into Palestine and Constantinople, the Western Nations first adopted the use of rich garments, which they wore over their armour The Saracens also wore tunics, or close garments, over their armour, of plain or striped stuff, which custom was followed by the Crusaders

Uniformity— *Vide* Measure of Uniformity

Union Jack—The national flag of Great Britain and Ireland The ancient English flag was the banner of St George , on the union of Scotland with England, the banner of St Andrew was added, and on the union with Ireland, that of St Patrick,—of which three the Union Jack was compounded It now consists of the red cross of St George, and a red and white diagonal cross, the last two being side by side. The whole are on a blue ground

Unit— The base of any number or thing upon which future calculations are made, as a brigade is of an artillery command

Unlimber — To disconnect from the gun or carriage the limber attached to it It is performed with light field carriages by two of the numbers, sometimes assisted by a third, taking hold of the trail handle and lifting the trail off the pintail hook

Unslaked Lime — Another name for quick-lime

Unspike — Extracting a spike from a gun, which can be performed by one of the following methods Fire a full charge, double shotted, and lay a leader of quick-match along the bore,* or ram junk wads over the charge, laying quickmatch also, in this case, along the bore, in a strip of wood, with a groove on the under side Or take out some of the metal at the upper orifice of the vent by pouring nitric acid into the groove for some hours before firing If this method, several times repeated, is not successful, unscrew the vent piece, or drill a new vent

V.

Vacuum — Empty space from which all atmospheric influence has been withdrawn, thus, the air exhausted from under a receiver by an air-pump causes a *vacuum*

Valise—A cylindrical case covered with cloth, which is placed behind the cantle of a mounted man's saddle In the artillery service, it contains the driver's kit

Valve—In hydraulics, &c , a lid over an opening which is so contrived that it shall open by excess of pressure

in only one direction, to permit a fluid or gas to pass, as soon as the excess of pressure is removed, it again closes and prevents its return

Vanguard—The advanced guard of an army

Variation of the Compass—Is thus explained in Lardner's Handbook of Natural Philosophy "By comparing the direction of any celestial object, whose real azimuth is known, with the direction of the needle, its apparent azimuth will be found, and the difference between the apparent and real azimuth is in that case the variation of the compass"

Varnish—Is a solution of resin, or of a gum resin, in a liquid, which being spread over a surface, evaporates, and leaves the solid in the form of a brilliant, transparent film The principal substances used in varnishes are the following —

Solvents	Solids	Colours
Oil of Nuts	Amber	Gamboge, Annatto
Oil of Linseed Oil of Turpentine	Anime Copal	Dragon's Blood Red Saundees
Oil of Rosemary	Lac	Aloes, Cochineal
Alcohol Ether	Sandarach Mastic	Saffron, Indigo
Wood Naphtha or Pyroligneous Ether	Dammer Common Resin	Turmeric

The resins, or, as the varnish-maker calls them, gums, may be used eit... singly or combined, and the sam... remark applies to the solvents. O... of the most desirable qualities in varnish is durability, a quality whic... depends greatly on the comparati... insolubility of the resin employed, i... hardness, toughness, and permanen... of colour The following is a go... varnish for polished iron-work tool... &c

Spirits of Turpentine, 4 lbs
Dammer 1 lb

Put the spirits of turpentine into... large bottle, pound the dammer ve... fine, and pour it gradually into t... bottle, keeping the composition... intervals well stirred When all t... dammer is well mixed, place the bot... in the sun for 3 or 4 hours, and wh... thoroughly amalgamated, the compo... tion is fit for use Apply lightly, t... varnish quickly dries, and is alm... imperceptible

To keep Rust from Iron

Pure Grease 6 lbs
Rosin 2 „

Pound the rosin fine, boil the grea... and after skimming from any impu... ties, mix the rosin well with it, th... cool the mixture, and apply it to yo... iron works

Vedette—A mounted sentry ... tached from a piquet The duties... vedettes are thus described in t... Queen's Regulations "The vedet... or sentinels on out-posts are to... placed so that they can best obse... the approach of the enemy, and co... municate by signal to their respect... posts, as well as to each other, ... night, or in thick weather, they are... be double"

Velocity—The rate of motion... a particle at any instant of time... called its "velocity" at that insta...

The velocity of a particle moving uniformly is measured by the distance passed over in any assumed unit of time, and the velocity at any proposed instant of a particle in variable motion, is measured by the distance which would be passed over in an unit of time, if the motion from that instant were to continue uniform during the unit of time

In gunnery, the velocity of spherical and elongated projectiles is determined, now-a-days, with instruments of extraordinary ingenuity and accuracy, enabling the operator to calculate the resistance of the air to such projectiles, either at the muzzle of the gun or at any point in their flight From the observations taken with these beautiful instruments termed "chronographs," all ballistic problems can be solved *Vide* Professor Bashforth's and Captain W H Noble's reports and experiments for determining the resistance of the air to projectiles

Vent—The channel or communication in a piece of ordnance between the priming powder or friction tube and the charge The vent in smooth-bored cast-iron guns is in a plane at right angles to the axis of the piece, but slightly inclined to it In heavy built-up guns, it is bored vertically

Vents are $\frac{2}{5}$ths of an inch in diameter The vent in bronze guns is not drilled in the metal of the gun, but in a copper plug, which is screwed into the piece, copper is used in consequence of the peculiar property it possesses of withstanding the action of ignited powder better than other metals The vents used in cast-iron guns are made also of copper, as well as those of rifled guns, but specially hardened There are two kinds of copper bushes for smooth-bored guns,—*viz*, the "through vent," and the "cone vent" The through vent is a cylinder of $1\frac{1}{8}$ inch in diameter cut with a screw thread $1\frac{1}{16}$ inch deep, and having a square head, by means of which the bush is screwed into the gun

A cone vent is of the same shape and size as a through vent, except near the end, where the screw thread terminates and the cylinder merges into the frustrum of a cone, $1\frac{1}{4}$ inch in length, and $\frac{7}{8}$th inch in diameter at the extreme end

When a gun is to be bushed for the first time, a cone vent is invariably used, because the copper will be denser and tighter at the bottom of the vent than would be the case with a bush screwed all the way down The vent in M L R guns does not enter near the end of the bore as in S B guns, but at a point $\frac{4}{5}$ths the length of the service cartridge from the end, for it has been proved by experiment that by igniting the cartridge at this point, the maximum initial velocity is obtained

Verdigris—Oxide of Copper

Vernier—A graduated movable index used for measuring minutely the equi-distant divisions of a graduated scale As described by Mr Heather, in his Treatise on Mathematical Instruments, it is so constructed as to slide evenly along the graduated limb of an instrument, and permits of distances being measured or observations read off with remarkable nicety In the vernier scale, described at page 11 of Mr Heather's work, the divisions on the lower or subsidiary scale are longer than those on the upper or primary scale In the vernier now to be described, the divisions are usually shorter than those upon the limb to which it is attached, the length of the graduated scale of the vernier being exactly equal to the length of a certain number (n—1) of the divisions upon the limb, and the number (n) of divisions upon the ver-

nier being one more than the number upon the same length of the limb

Let, then, L represent the length of a division upon the limb, and V, the length of a division upon the vernier so that $(n-1)\,L = n\,V$, and therefore

$$L-V=L-\frac{n-1}{n}\,L=\frac{1}{n}\,L,$$

or the defect of a division upon the vernier from a division upon the limb is equal to the nth part of a division upon the limb, n being the number of divisions upon the vernier

Vertex—The summit, height, the culminating point of a shot's curve or trajectory

Vertical—Upright, perpendicular to the surface of the earth or smooth water

Vertical Fire—The fire from ordnance at high angles, for instance from mortars, which being generally fired at an angle of 45°, the shells are observed to attain great height in their flight and to descend at considerable angles Major (now Lieutenant-Colonel) Owen, in his lectures on Artillery, remarks that "the fire of shells from mortars at high angles of elevation is most uncertain as regards accuracy, the reasons of this are, that the shells having comparatively low velocities but long 'times of flight' are peculiarly liable to considerable deviations from wind and other disturbing causes, also that the angles of descent of mortar shells, fired at the usual angle of 45°, are so great, that unless the object be of some extent, an error in range of a few yards over or under might render the shell useless, whereas, when a projectile is fired at a low angle of elevation, so much ground is covered by it before and after grazing, that a few yards under or over would not probably prevent it striking the object The very greatest care is required in weighing out the charges, for if this is performed carelessly, considerable differences will occur in the ranges In vertical fire, as the object cannot be seen and the piece is generally short, it is very difficult to lay the mortar exactly in the same line for a number of rounds, but if laying could be performed with the greatest accuracy, still irregularities would always occur in practice with projectiles fired at high angles and with low velocities" The following general rules for mortar practice are here given "Although it will be found in practice that the charges of powder for similar ranges will constantly differ, owing to the varying strength of the powder, according to the state of the atmosphere, &c, the 13-inch mortar with a charge of 3lbs of powder gives a range of 850 yards and every additional ¼lb increases the range about 180 yards The 10-in mortar, with half the charge of the 13-in, will give about the same range The 8-in mortar, with about one-third of the charge of the 13-in, will also give about the same range The elevation of the mortar for the above must be 45°, at 15° the range is rather more than half that of 45°, at 10° rather less than half, the charges being equal"

Vertigo—Mad staggers, a disease which horses occasionally suffer from

Vibration—The regular reciprocating motion of a body, as a pendulum, musical chord, &c The effect of the accumulation of vibratory motion is displayed in the case of suspension bridges, some of which have been brought down by the steady marching of a body of troops, owing to the fact of the steps of the troops synchronizing with the oscillations of the bridge

Vice—A tool for holding any article while operating upon it, by

placing it between two jaws or nippers, and screwing them towards each other

Vice, Hand—Used for filing small articles, a greater number of which are more conveniently filed whilst they are held with the left hand, the file being then managed exclusively with the right This enables the artizan to judge more easily of the position of the file In some cases a piece of wood called a filing block is fixed in the table or tail vice, and square, round, and similar pieces are rested in one of several notches made in the block with a triangular file If the works are rectangular, or have flat surfaces, they are held quite at rest, if they are circular, they are continually rotated

Viceroy — A title sometimes given to the Chief Officer of an independency, who possesses delegated powers from the Sovereign to represent the supreme authority,—as the Lord-Lieutenant of Ireland and the Governor-General of India

Victoria Cross — A reward "for valour" The order was instituted by Her Majesty Queen Victoria in 1856, and is bestowed upon such members of the naval and military services as show conspicuous acts of gallantry on service in the field It consists of a Maltese cross made of bronze, with the royal crest in the centre, and underneath is inscribed "for valour" It is worn with a red ribbon in the army, and blue in the navy The order is open to all, whatever the rank, and however short the term of service of the individual may be

Victory—The overthrow or defeat of an enemy, success in contest In Brande and Cox's Dictionary, it is stated that, in Roman mythology, Victory is described as a goddess, called Vario, the daughter of Heaven and Earth Her altar was preserved in the Curia, or senate house, of Rome, and its destruction was the subject of one of the latest contests between Christians and Pagans.

Viewer—An examiner of small-arms, or stores generally

The following are the instructions laid down for the guidance of viewers appointed to attend the annual inspection of arms in possession of the troops in the several districts in Great Britain and Ireland, which are published for the guidance of Chief Civil Master Armorers, attending annual boards of survey on arms of British regiments in India, in supersession of Instructions 2, 3, and 4, published in Adjutant-General's Circular Memo, dated 2nd January 1868 —

1 Examine the exterior of the arm for general appearance, as in the case of an upright view Should the arm exhibit appearances of rust at the barrel edge, lock, or other parts, it must be stripped and carefully examined

2 Examine the action of every arm most carefully, and ascertain that the moving parts work freely, and fit firmly and soundly See that the face of the block has not been injured by the striking of the cock when open, and that it has not been smoothed or polished, any attempt on the part of the Armorer Sergeant to touch the face of the block with a file, or emery paper, should be at once checked

The pistons to be carefully tested as to their working freely, and a few should be taken out to see that they, as well as the springs, are cleaned, slightly oiled, and free from dirt

Although a flat gauge of 015 inch is given to every viewer to examine the amount of play in the block with, yet it does not follow that an arm which admits of the gauge should be

condemned, as the ammunition is much stronger than it was at the time when that gauge was established

All arms, however, which are complained of for cutting the cartridges, or for difficulty in extraction, are to be put on one side for close examination and repair

3 Examine the lock, by pulling up the cock, to ascertain that it works freely If found to be sluggish, the lock to be removed from the stock, cleaned, and carefully examined The bedding in the stock also to be examined, to see whether it shows an appearance of being wood-bound

At least 10 per cent of all locks to be taken out of the stocks The viewer will exercise his judgment, from general appearances, as to the necessity for removing a larger proportion

4 Examine the bores of the barrels to ascertain that they are not injured or neglected, but kept clean and in a proper state

No notice need be taken of stains or slight scratches arising from fair wear The 577 plug is to be occasionally used and passed through the barrels in all cases of doubt or appearance of obstructions

Only in cases of complaints of bad shooting, or where barrels exhibit distinct appearances of excessive wear from improper cleaning or other causes, and where the *shooting* is also complained of, should the viewer use the 580 plug, as it is always to be borne in mind that accurate shooting does not depend upon the exact adherence to the gauge of the bore 577

Straightness of the barrel is of much more importance for correct shooting, than slight variations in the diameter of the bore

The viewer will, of course, pay more particular attention to those arms which are specifically complained of, and will endeavour in every way to arrive at a correct judgment upon the cause of the complaint, which may arise from a combination of several defects and injuries

He will never condemn, or place on one side for exchange, any arm which merely takes the 580 plug, either wholly, or in part, unless the aim is proved to have shot badly at a special trial, according to Horse Guards Circular of 6th October 1863, General No 276

5 In the general examination of the arm, the trigger should be carefully tested, as to its working freely and pull-off

In all cases where found to be stiff, the guard and trigger plate must be removed and carefully examined

A percentage of the arms under view (to be settled by the viewer after their general condition has been ascertained) should be *completely* stripped and carefully examined This percentage should not be less than 10 per cent

Lastly, the viewer must carefully note the general way in which the Armorer Sergeants and Serjeant Instructors of Reserve Forces have performed their duties as Armorers, together with the nature of all repairs, and how executed

Vis-inertiæ—The propensity of nature to remain in its actual condition, whether of motion or rest, and to resist change

Vis-viva — The vis-viva of a work is its mass multiplied by the square of its velocity , work or dynamical effect supposes a body moved, and a resistance overcome , and either of these without the other is insufficient to constitute work The work produced by a pressure moving a body through a certain space, is defined to

be the product arising from multiplying the pressure by the space through which this pressure acts

Visual Ray—The line of sight

Vitrify — To change into glassy matter

Voltigeurs — A French corps of light infantry, formed by the first Napoleon They differ from Tirailleurs, as they move in a compact body Each regiment of the regular infantry of the army has a company of Voltigeurs attached to it On nearing the enemy, all the companies of Voltigeurs unite, and are the first in the fray They are armed with a carbine and a short broad sword

Volunteers—An unpaid body of men assembled for the defence of a country and as an auxiliary to the regular army Formerly, volunteers assembled only in time of war, but of late years there has been a standing Volunteer Army in England amounting to about 200,000 men The Government supply arms, and a small sum is voted yearly for the clothing of this force Officers of Volunteer Corps rank as juniors of their respective ranks, with officers of the Regular Fencible and Militia Forces

Voucher—A written document or proof upon which any account of public charge is established

Vulcanite — Composed of two parts of caoutchouc, and one part sulphur, boiled together at a temperature of 200° Faht It is used in the manufacture of water-hoses, combs, &c , and being a good insulator, is considered the best material for the covering of telegraph wires.

W.

Wadhooks — Form part of the stores attached to a battery, and are used for searching the bores of guns and withdrawing from them anything that would impede the loading

Wadmiltilts—Are strong rough woollen cloths, used principally for covering powder, and protecting ammunition generally A barrel of powder wrapped in a wadmiltilt is safe from the explosion of two similar barrels in the open, at a distance of 10 feet, but it is not safe when not so wrapped at a distance of 15 feet

Wads—There are several natures of wads in the service, which are used with both smooth-bored and rifled guns With the former *junk* and *grummet* wads , with the latter, *grummet* (when specially required), *papier mâché*, and Bolton's wads The latter are made of pulp, prepared from 75 per cent of old rags known as "tammies" or "woollens" and 25 per cent of old tarred rope, formed in a mould, and coated with a waterproof varnish when dry Junk wads are made of oakum bound round with spun yarn, and are of similar diameter to the bore of the gun for which they are intended They are used in firing hot shot and in proving ordnance, one or more being placed in front of the projectile With naval guns, they are usually placed immediately on the shot, so that they may prevent the shot from shifting its place or rolling out , also with siege guns, when depression has to be given to the piece Grummet wads consist of a piece of rope formed like a ring, the external diameter being equal to the calibre of the gun , they are used when firing at angles of depression, or at angles of elevation less than 3°, to place over the shot, and so prevent it from moving out of the piece Papier mâché wads were supplied for the 9, 8, and 7-inch muzzle-loading guns. but they were superseded shortly after their introduction by the

Bolton Wads The wads now used under the name of papier mâché are for securing (in conjunction with the metal plugs) the fuze and loading holes of filled shells

Gun wads are stated to have no effect upon the velocity of the ball, neither do they serve to lessen the windage, as the inflamed powder is found to escape past them It is further found from experiments that the grummet wad is more efficient than one of junk, both in preventing the cartridge from shifting its place in the bore of chambered ordnance, and in lessening the deviations of projectiles

Wagon—In the artillery service, a four-wheeled carriage attached to movable batteries It contains the larger proportion of the ammunition of the battery Light Field Batteries have one wagon attached to each gun on the peace establishment, and two on the war establishment, which enables a battery to go into action with an ample number of rounds per gun

Wagon, Forge—One is attached to each movable battery It is composed of a limber and carriage, the limber is the universal limber, but has one long box instead of two The body of the wagon contains the bellows and all the other articles necessary to complete the forge

Wagon, Heavy Sling—This wagon is used in the artillery service for transporting guns from 12 to 23 tons in weight It is similar in construction to the service wagon, but is made of African oak scantling of much larger dimensions, and is fitted with breaks similar to those on the 12-ton sling wagon, but worked by levers and eccentrics, the perch is fitted with a differential block and chain, and the axletree arms are special for the wheels

Wagon, Rocket—This wagon with its limber, which is intended to carry Hale's 9-Pr rockets, is the ordinary field ammunition wagon limber for rifled batteries The spaces are of the same length, but are narrower and deeper

Wagon, Store Limber—For carrying artificers' tools, materials, and stores One allowed to each movable battery

Wahrendoff Gun—A two-grooved breech-loading cannon invented by Baron Wahrendoff, a Swedish nobleman, in 1846 The mechanical contrivance for securing the breech is very superior to the rude process of earlier times, but it appears doubtful whether this mode of closing it is strong enough to ensure safety when high charges are used For a description of the gun, *vide* Sir H Douglas's Naval Gunnery Experiments made with this gun at Shoeburyness showed that it was capable of long range, but the deflection was so great and variable that no allowance could be made for it in laying the gun with respect to the object

Wall Knot—A knot made at the end of the lever and prypole rope, to prevent it from being drawn through the hole in the lever

Wall Plate—A piece of timber lying on a wall, on which girders, joists, and other timbers rest

Walnut (*Juglans Regia*)—A tree indigenous to Persia It has long been introduced into Great Britain, and is a dark-coloured and close-grained wood It is largely used for the stocks of small arms The walnut grows also in the Himalayas and in the upper provinces of Burmah

War—Is a contest carried on between the armed forces of two nations, after every endeavour has been resorted to by one side or the other, and often by

friendly powers, to bring about a reconciliation, as was the case on the part of England, before the war between France and Prussia broke out in 1870

Sad and disastrous as are the effects of war, history admonishes us that as in the past mankind has ever been prone to arms, so in the future must such conflicts be inevitable, however peacefully disposed the interests of nations may be It behoves rulers therefore to be prepared to avenge insult, and to repel encroachment, and by an attitude of determination, to avert, if possible, the dread necessity of recourse to arms

In furtherance of this state of preparedness, much has to be done and thought of before a nation can be said to be ready for war An army is not raised and disciplined in a day, nor is the acquirement of instruction in its various elements the light task which some suppose it to be Thorough and practical knowledge of the art of war must be imparted to all ranks during peace, so that when the day of trial comes, no arm shall be found deficient

It cannot be too often impressed on the officers of an army that the art of war is no easy subject, but, in these days, when it has become a science, requires careful study of the best authors, combined with personal experience of warfare, and an intimate acquaintance with the laws which govern strategy and tactics

To trust to numbers, and to lack the ability or knowledge to dispose of them, is unsafe , indeed, without this knowledge, ruin, rather than success, must be expected The study of the late war on the continent will afford many a lesson, and much information to the military reader, as to how armies may be destroyed, and opportunities lost, by bad generalship, and success ensured when troops are properly and scientifically handled

The subject under consideration is one of such magnitude that it is not possible in a work of this kind to enter into a description of its various phases we can only refer those interested in the subject to Colonel Macdougall's Theory of War, and Colonel Hamley's Operations of War, as well as to Colonel Chesney's articles in the Edinburgh Review published in 1866, which will give the best insight into the art of war, the management of an army, and the qualifications required of the General in command to bring a campaign to a successful issue

Warrant—In a military sense, a writ of authority inferior to a commission also a document under the Sign Manual to authorize the assembling of a General Court Martial

Warrant Officers—Are officers who are not commissioned, exercising their authority by warrant only There are several departmental grades of Warrant Officers in the Indian Army *Vide* Conductor

Washer, Drag — A flat iron ring on the axle arm of carriages, having an iron loop attached to it for the purpose of fastening the drag rope when necessary,—hence the term *drag-washer* It is placed on the axle arm to prevent the wheel or nave from pressing upon the linch-pin

Water-deck — A water-proof covering for the valise, either made of India rubber or fine oil-cloth

Water or Fire Engine — A portable machine used for extinguishing fires The following notes regarding the preservation of water-engine hoses will be found useful —

" The engine, hose, and implements, &c , should be invariably kept

in good condition, and fit for immediate use, if required. After every working of the engine, all component parts should be carefully examined, and any slight repairs that may be needed effected immediately.

"The hose should not be dragged along the ground, but after use should be coiled and taken to the work-yard to be cleaned. If of leather, it must be washed clean, hung up to drain, and while partially wet, a mixture of neats-foot and cod oil rubbed on with a brush. If of canvas, it must also be washed clean, hung up to drain, and not folded until perfectly dry. It should, whether of leather or canvas, be unfolded at least once in every six weeks, and kept exposed in an airy place. If kept too long coiled, leather is liable to heat and harden. When it has had a good airing and is well softened, it may be again coiled. Anoint leather hoses with the mixture above given at least once in every two months.

"If the engine has been sent away for use on account of a fire (or after travelling), wash it on its return before dirt has had time to harden, and pump clean water through the works, moving the levers rapidly to remove mud, grit, &c. The cylinders, after being wiped dry and clean, should be examined to see if they have sustained any injury, and the pistons covered with salad or olive oil for lubricating the cylinders and keeping the leather cups moist. When you play an engine, place the branch pipe, if possible, in such a position that its jet may be assisted by the wind. In extinguishing fire, the branch pipe should be brought as near as possible to the premises on fire, and if the firemen cannot enter the house or building, use ladders, if desirable. What is wanted is, to play with full power on the burning materials and cut off the flame at its source. It is the *force* of the water and not the *quantity* that has the greatest effect. The men working an engine should commence pumping slowly, gradually increasing or quickening the movement, throwing all their weight on the down stroke, and allowing the handles to rise by the depression of the levers on the other side."

Water-proof Paper.—Paper that has been impregnated with a solution of bees'-wax dissolved in rectified coal tar naphtha, in the proportion of 2 lbs of wax to one gallon of the solvent. This has been proposed by F. A. Abel, Esq., Chemist, War Department.

The water-proof bags for Snider-Enfield Rifle Ammunition are formed of two sheets of paper made perfectly water-proof by an even intermediate layer of India rubber. This paper is cut to the size required, and the ends and sides joined by coating the overlaps of ¾ in. with India rubber cement, which, when dry, are pressed together with an elastic roller.

The India rubber solution is composed of—

Naphtha	98½ lbs.
India rubber	21½ lbs.

and the cost of making 1,000 of these water-proof bags is estimated at £1-0-2¼.

Wax.—An organic product of considerable importance, is obtained from different sources, the chief of which is the bee-hive, where it is used by the bees in the formation of their cells. The characteristic properties of good wax are its roughness when chewed, its non-adherence to the teeth, and its fragrant honey-like smell. The substances generally used to adulterate wax, are resin, tallow, and earth,—the latter may be detected by melting the

wax, when the earth will subside to the bottom as it cools, and may be removed with a knife

Tallow may be inferred when the wax breaks smooth, and adheres to the teeth when chewed, also by the absence of the honey-like smell Resin may be detected by putting small pieces of wax in spirits of wine , the resin will be dissolved, leaving the wax uninjured

When the wax has served its purpose in the domestic economy of the hive, it is collected for manufacturing purposes, and goes through a certain refining process before it is taken to the market Bees'-wax is now largely used as the ingredient in lubricating cartridges, and undergoes the following examination before it is employed for this purpose —

"*Examination of Bees'-wax for Cartridges*

"Press a small fragment of wax repeatedly between the first finger and thumb, so as to spread it down the latter The wax should curl away from the thumb as the finger descends If it clings tightly to the thumb and becomes very soft and smeary, the adulteration with some description of fat is indicated This test, though very crude, is sufficiently good to serve for the detection of any considerable adulteration of this kind A piece of *blue litmus paper* pressed upon a piece of the wax (with a knife or rod, but not with the finger) which is thus heated gently on a metal service, until it begins to melt at the edges, should exhibit no change of color to red Several fragments of wax are placed in a wide test tube and gradually heated (the tube being moved in and out of the flame) until perfectly melted The wax in this state should be quite clear and transparent, and free from mechanical impurities The heat should be applied to the wax until the portion of the tube containing it can no longer be touched by the finger (the temperature being about 220° Faht) If it has then exhibited no signs of frothing, it is free from water If much of the latter be present, the wax will begin to froth even before it is completely melted, and as the heat is raised, a crackling noise will be noticed Water may be expelled from wax by maintaining the latter at a temperature of from 200° to 220° Faht until frothing cases"

Web—A material used in a saddle It is made of coarse canvas 9″ × 3″, nailed across the two side bars Its use is to prevent the seat of the saddle from being pushed up by the peg on which it hangs

Wedge—One of the six mechanical powers It is commonly used for separating bodies which are strongly bound or pressed together, as, for cleaving timber, in which case it is urged by percussion It is also sometimes used in raising heavy bodies

Wedge Gun—Is in general construction similar to the B L rifled guns of the service, and rifled on the same principle, so as to fire a lead-coated shot, but the method of closing the breech is different from that of the screw and vent-piece gun It is thus explained in Lieut -Colonel Owen's Modern Artillery —"In the wedge and stopper gun a slot passes through the breech from side to side, and the parts which close the bore are therefore inserted or withdrawn at the side of the piece, instead of at the top , by this arrangement the gun may be loaded more rapidly, and with much less labor, and the detachment is less exposed than with the screw and vent-piece gun"

Weights of Animals—An

Elephant (including his load of 13 cwt) weighs 72 cwt, of which $\frac{4}{10}$ths is borne on the hind legs

The weight of an elephant in draft may be taken as 66 cwt

A Camel Average weight, 15 cwt this includes the load, 4½ cwt

Pack bullock —Average weight, 5½ cwt, which includes the load, 1½ cwt

A Cavalry Horse with rider weighs about 1,400 lbs This is allowing 18 stone for the rider

Weights and Measures—*Vide* Appendix

Welding—Is the art of joining together two pieces of iron by means of heat In technical language, this is called *shutting together* or *shutting up* The operation bears some resemblance to what in carpentry is called *scarfing*, but in smith's work, the joints, also called *scarfs*, do not, from the adhesive nature of the iron when raised to the proper temperature, require any accessories answering to the glue, bolts, straps, and pins, used for joining wooden beams and girders In joining two cylindrical ends, the scarfs required for the *shut* are made by upsetting or thickening the iron by first hammering its extremities, it is then rudely tapered off to the form of a flight of steps, and the sides are slightly bevelled or pointed The two extremities are next raised to the welding heat, when a little sand is sprinkled upon each, this fuses and spreads into a kind of varnish, which defends the hot metal from the oxidising influence of the air The proper heat has been attained when the iron begins to burn away with vivid sparks Two men then take each one piece, strike them forcibly across the anvil to detach any loose cinders, place them in their true positions for the joint, when they are united by two or three blows of the fireman's hammer, and his assistant completes and finishes off the work with a sledge hammer. The end is next *jumped* upon the anvil and struck end way, to prove the soundness of the joint, or to enlarge the part, should it have become reduced in size by the welding

Wheels—Those of artillery and other carriages are composed of three independent parts,—*viz*, the nave, spokes, and felloes, which, when put together, form the wheel The several parts of the wheel are formed either by hand or by machinery Of the iron portion of the wheel, there is the tire, which forms a band round the circumference of it which is 3 inches in breadth, and also the pipe or nave box, which is a truncated cone, divided internally into three parts, the centre of greater diameter than the others, for the purpose of carrying grease Wheels for artillery of Light Field Carriages are all of one diameter,—*viz*, 5 feet, also the wheels of ordinary heavy gun-carriages, but the limber wheels are only 4½ feet All gun-wheels have what is termed a "dish," which is the required angle with the nave at which the spokes of the wheel are fastened or driven into it By inserting the spokes at this angle, a hollowness is formed in the wheel, the spokes not being perpendicular to the plane on which the wheel stands, but having a slope outwards to the nave The object of the spokes being thus placed is to strengthen the wheel against lateral (side) pressure, the spokes at this particular angle forming so many crops meeting and counteracting the lateral pressure, and as the wheel revolves, each spoke in its turn receives the weight of the carriage perpendicularly The Madras gun-metal nave having now been introduced into the service,

the reader is referred to the heading "Nave" for a description of it

Wheelers—The shaft horses of a gun-carriage The term is also applied to the mechanics of a battery engaged in setting up the wheels of gun-carriages

Whipping—To whip a rope is to tie a piece of twine round the end to prevent the stands being laid open

Whitening for Belts—Used for cleaning soldiers' buff accoutrements, and is composed of white lead mixed with water and a little gum Arabic

Whitworth Gun—Is an hexagonal rifled wrought iron gun invented by Mr Whitworth From accounts given of this gun, it appears to combine durability with length of range, accuracy, and penetration The following description of the Whitworth gun is taken from a work on Naval Gunnery by Lieutenant Simpson, U S N "The method of rifling adopted by Mr Whitworth consists in making the bore of the gun of a hexagonal spiral form, by which rotation is impressed upon the projectile by effective rifling *surfaces* instead of by spiral *grooves* and the non-effective *lands* of a cylindrical bore The projectiles being of the same hexagonal form externally as the bore is internally, and no forcing process required, metals of all degrees of hardness may be employed This simple mechanical principle admits of application to fire-arms of every description, provided they are of sufficient strength to resist the strain put upon them by the rifling principle

"Mr Whitworth first applied his system to rifle muskets, and with such success as, in all the comparisons made between it and the Enfield rifle, to excel the latter in accuracy and penetration

"The great strain put upon a gun rifled in the ordinary manner, at the instant of discharge, is occasioned by the force exerted upon the projectile to overcome ts natural *vis-inertiæ*, together with the force required to cause the soft metal, of which the projectile is formed, or with which it must be coated, to enter into the grooves of the bore whereas by the system of rifling by surfaces, and not by grooves, the projectile, not being forced into another form, is more easily set in motion

"Mr Whitworth entirely eschews the method of giving a gaining twist to the spiral of the bore, as obviously dangerous, by causing increasing strains upon the gun in the chase and at the muzzle, just where the diminishing thickness of metal in the gun requires relief, and to which malformation of the Lancaster gun may be attributed the frequent burstings of that gun at or near the muzzle, which occurred in numerous experimental trials, and subsequently happened on service at the attack of Sevastopol, where, on one occasion, the whole muzzle of a gun was blown off by the increasing strains thus put on it, having got rid of which weak part, the gun continued to be used with safety and effect as a howitzer

"The ball presents many surfaces and points calculated to interfere with its accuracy of flight through the air, it is to overcome this that such a rapid motion of rotation is communicated to the ball, an idea of the rapidity of this motion may be formed by noticing the measure of twist in the 3-Pr, the piece from which the most wonderful results have been obtained In this piece, we have one turn in 3 feet 4 inches, and as the piece itself is only 6 feet in length, the ball is required to make nearly two entire revolutions before leaving the bore, in spite of the great strain that is thus brought upon the

gun, it is said to be very strong, and the 3-Pr has been fired fifteen hundred times, chiefly at high elevations, without the gun exhibiting any injury or signs of wear

"The Whitworth field gun is a breech-loading piece, the arrangement by which the breech is closed consists of a cap screwed on externally, this cap works in an iron hoop, jointed to a projection at the side of the breech, and which, when returned to its proper place, is screwed externally to the breech piece The shot is first put into the gun through the breech, then the powder in a tin case filling exactly into the hexagonal bore of the gun, having a lubricating wad attached to the fore-part of it, which at each discharge sponges out the gun, the tin case remaining in the chamber, the door is then closed when the cap-screw fits on to its place, and three turns of the screw handle screw it on to the piece The vent lies in the centre of the breech piece

"The Whitworth guns are all made in masses of 'homogeneous' iron, and bored out of the solid The large guns are strengthened by wrought-iron hoops applied by hydraulic pressure The projectiles are simple, uncoated, hard metal bolts of various shapes, according to the purpose for which they are employed They are all made by self-acting machinery, and so nicely shaped that their bearing surfaces fit with the utmost exactitude, the rifling principle being executed by the machinery in the workshop, and not produced by the explosion in the gun For firing through soft substances and into masonry, tubular projectiles are employed, for piercing thick plates of wrought-iron, flat-fronted projectiles, made of homogeneous iron, are used For ordinary practice, and where length of range is important, the fore-part of the projectile is made to taper slightly, the front being rounded off, and the rear part is made nearly to correspond with the fore, with regard to the degree of taper, but its end is flattened, and sometimes slightly hollowed out In the Whitworth gun, projectiles of any length, and charges of powder of any amount, may be employed It is said that the Whitworth 3-Pr fired off ten shots, placed one on another, and that a projectile, ten diameters in length, was fired from a howitzer, rifled according to the Whitworth system, without injury to the gun"

Though most of Mr Whitworth's guns are breech-loaders, he has lately made some heavy muzzle-loading guns

Wicket — A small door in the gate of a fortified place, affording a free passage to and fro, without opening the great gate

Windage — Is the difference between the diameter of the shot and that of the bore This definition Lieut-Colonel Owen says has been objected to, and he defines it as being strictly the difference between the area of a section of the bore at right angles to its axis, and the area of a great circle of the shot The windage allowed for smooth-bored ordnance of the British service is 1 for light guns, 125 for heavy guns, and 08 for M L R guns Windage in a muzzle-loading gun is necessary in order that the projectile may enter the piece easily, and that the service of the gun may never be interrupted by jamming, also to allow of the expansion of the shot when heated

Windgall—In veterinary practice, so called from a former erroneous notion that it contained air, abnormal enlargement from overwork of the little sacs containing fluids, destined to lubricate the complicated tendons of the leg

Remedy, if large, bandage with ointment, in severe cases, fire This complaint was formerly very common from bad shoeing

Windlass—An axis or roller of wood, square at each end, through which either cross-holes are pierced for handspikes, or staves are fixed cross-ways to turn it round, as it revolves, it draws a cord or chain, one end of which is attached to a weight, which is thus raised from any depth

Wire—Is produced from malleable metal, passing through draw-plates of specific sizes until it attains the thickness requisite

Wooden Bottoms — *Vide* Sabots

Woolwich Gun—Is a modification of the French rifled system, the grooves being shallower, and having their corners rounded off

The present 7, 9, 10, 11, and 12-inch guns, which are made of wrought-iron coils, are rifled after this system, with three or more grooves according to the calibre of the piece, and the practice from these guns, as well as their endurance and penetration, has been most satisfactory, the 7-inch gun, especially, being a great success as regards its shooting qualities

Work—Is defined as follows in Brande and Cox's Dictionary "The work performed by any force is measured by the product of the force into the space through which it is exerted In Britain, the *unit of work* is called the *foot-pound*, and is that which is performed in raising a pound weight, in opposition to gravity, to a height of one foot The work required to raise five pounds to a height of ten feet, therefore, is fifty *foot-pounds*

Work Done — In gunnery, as explained by Captain (now General) Boxer, denotes a certain pressure exerted through a certain distance It is measured by the product of the pressure, and the distance through which this pressure acts, the element *time* does not necessarily enter into the expression

Woulding or Packing Hitch — A knot for tightening a rope

Y.

Yard—A measure of 3 feet The English standard yard of 1760, lodged in the custody of the Clerk of the House of Commons, is made the standard or unit for all measures of extension whatsoever, and $\frac{1}{36}$th of such yard = 1 inch

Yarn — Wool, cotton flax, &c, spun into thread It is used sometimes in binding fascines Its quality is expressed in English by numbers denoting the number of hanks in a pound weight (avoirdupois), reckoning the length of the hank of cotton yarn at 840 yards, or 7 lengths of 120 yards each

Year—Sidereal, is the time occupied by the earth in moving in its orbit, or apparently the sun in the ecliptic, from a determinate point in relation to any fixed star to the same point again, and consists of 365 days, 6 hours, 9 minutes, 12 seconds

Year — Solar or tropical, is the time which the earth takes in moving in its orbit, or apparently the sun in the ecliptic, from one equinox or tropic to the same again, consisting of 365 days, 5 hours, 48 minutes, 49 seconds

Yeomanry—The collective body of yeomen or freeholders possessing land of their own During the revolutionary wars of France, they formed themselves into troops of horse, known now as the Yeomanry Cavalry of Great Britain, chosen from among the gentlemen and yeomen of each county They are volunteers, but are liable to be called out in aid of the

civil power They receive an allowance of £2 per man per annum from the Government, each man has to feed his own horse In case of invasion, or a threatening of invasion, they would have to assemble for actual service, and be liable to be sent to any part of Great Britain, and while so embodied would then be subject to the Articles of War

Yokes—Are required for bullock draught, they answer either for pole or trace The clip band is attached when used as a pole yoke The yoke consists of two wooden bars, an upper and lower bar connected by two iron rods at a distance equal to the depth of the largest-sized bullock's neck, and about a fourth of the length from each extremity of the bar Near the extremities of the wooden bars are two movable iron rods, fastened by rings, and which can be disengaged when the bullock is being put to or yoked in On the upper bar, a clip band and swivel are fastened for the purpose of attaching the yoke to the pole

Z.

Zenith—Is that point in the heavens directly over our heads The zenith to us is the nadir to our antipodes Circles drawn through the zenith and nadir of any place, cutting the horizon at right angles, are called azimuth or vertical circles

Zero—That point on a scale marked 0, or nothing In the graduation of a thermometer, such as Reaumer's and the Centigrade, the zero point commences at the freezing point of water In Fahrenheit's, the zero is 32° below the point at which water congeals, being about the temperature of salt and snow (*Vide* Thermometer)

Zig-zags of Approach—In fortification, are trenches pushed on during a siege towards the place besieged The trenches are constructed in a zig-zag direction, so that, when prolonged, they shall fall clearly without all the defensive works, that they may not be enfiladed

Zinc—This metal, in commerce frequently called spelter, was first mentioned by Paracelsus, in the 16th century, under the name of *zinetum* It does not occur in the native state, but is obtained from its ores, which are chiefly the sulphuret and carbonate of zinc It has long been imported from China into India The name Tutenague by which Chinese zinc was known in commerce, is evidently derived from the Tamil word "tutanagum," and it was at one time called Indian tin The ores of zinc were, no doubt, employed by the ancients in making brass Zinc (Zn=32) is found in the state of an oxide, but principally as a sulphuret (Blende) and an impure carbonate (Calamine) From both ores it is converted into an oxide by the process of roasting, and then reduced to the metallic form by the aid of carbonaceous matter, when it may either be fused or sublimed Until purified by a second distillation, it contains as impurities small portions of other metals, as iron, copper, arsenic, &c In the corrugation of iron, zinc is the metal that is used

Zinc Plates — Are used with Professor Grove's voltaic battery, in mining They are made of the purest rolled sheet zinc, and then coated with quicksilver, which preserves the surface, in a great measure, from being destroyed by the action of the sulphuric acid in which the plate is steeped

SUPPLEMENT

Accounts, Public—The system of accounts observed at the War Office is different to that detailed in this work, and will probably be the method eventually pursued in all Indian manufacturing establishments and arsenals

Caffin's Machines—Since the introduction of heavy charges for rifled guns, requiring great nicety in weight, these machines have become obsolete

Electric Telegraph — As described in Francis' Dictionary of Arts and Sciences, is "a means of rapid communication by the science of electro-magnetism It is known that when a current of electricity passes around a magnet, it occasions that magnet to diverge from its former position in proportion to the strength of the current In the electrical telegraph, a current is sent along a wire enclosed in a waxen or resinous material, to keep it dry and insulated, from one station to another, where it acts upon several magnets, in accordance to a similar set of magnets at the first station According to the manner in which it acts upon these, driving them to the right or left, more or less, it is instantly known what it is intended to communicate"

Freeburn's Fuze — Is now obsolete in the service

Indian Field Gun — The dimensions of this gun, with those of various foreign Horse Artillery guns, will be found in the Appendix

Gatling Gun—In the body of this work will be found, under the head of "Mitrailleur," a comparison as to the shooting qualities between the "Montigny mitrailleur" and the "Gatling battery," but no description is given of the latter It is therefore now inserted, from Dr Gatling's lecture at the Royal United Service Institution in 1870 —

"The gun consists of a series of barrels in combination with a grooved carrier and lock-cylinder All these several parts are rigidly secured upon a main shaft There are as many grooves in the carrier, and as many holes in the lock-cylinder, as there are barrels Each barrel is furnished with one lock, so that a gun with ten barrels has ten locks The locks work in the holes formed in the lock-cylinder on a line with the axis of the barrels The lock-cylinder, which contains the locks, is surrounded by a casing which is fastened to a frame, to which trunnions are attached There is a partition in the casing, through which there is an opening, and into which the main shaft, which carries the lock-cylinder, carrier, and barrels, is journaled The main shaft is also at its front end journaled in the front part of the frame

"In front of the partition in the casing is placed a cam, provided with spiral surfaces or inclined planes This cam is rigidly fastened to the

casing, and is used to impart a reciprocating motion to the locks when the gun is rotated There is also in the front part of the casing a cocking-ring, which surrounds the lock-cylinder, is attached to the casing, and has on its rear surface an inclined plane, with an abrupt shoulder This ring and its projection are used for cocking and firing the gun The ring, the spiral cam, and the locks, make up the loading and firing mechanism

"On the rear end of the main shaft, in the rear of the partition in the casing, is located a gear wheel, which works to a pinion on the crank-shaft The rear of the casing is closed by the cascable plate. There is hinged to the frame in front of the breech-casing a curved plate, covering partially the grooved carrier, into which is formed a hopper or opening, through which the cartridges are fed to the gun from feed-cases The frame which supports the gun is mounted upon the carriage used for the transportation of the gun

"The operation of this gun is very simple One man places a feed-case filled with cartridges into the hopper, another man turns the crank, which, by the agency of the gearing, revolves the main shaft, carrying with it the lock-cylinder, carrier, barrels, and locks As the gun is rotated, the cartridges, one by one, drop into the grooves of the carrier from the feed-cases, and instantly the lock, by its impingement on the spiral cam surfaces, moves forward to load the cartridge, and when the butt end of the lock gets on the highest projection of the cam, the charge is fired, through the agency of the cocking device, which at this point liberates the lock, spring, and hammer, and explodes the cartridge As soon as the charge is fired, the lock, as the gun is revolved, is drawn back by the agency of the spiral surface in the cam acting on a lug of the lock, bringing with it the shell of the cartridge after it has been fired, which is dropped on the ground Thus, it will be seen, when the gun is rotated the locks in rapid succession move forward to load and fire, and return to extract the cartridge shells In other words, the whole operation of loading, closing the breech, discharging, and expelling the empty cartridge shells, is conducted while the barrels are kept in continuous revolving movement It must be borne in mind that, while the locks revolve with the barrels, they have also, in their line of travel, a spiral reciprocating movement, that is, each lock revolves once and moves forward and back, at each revolution of the gun

"The main features of the gun may be summed up thus —

"*1st* —Each barrel in the gun is provided with its own independent lock or firing mechanism

"*2nd* —All the locks revolve simultaneously with the barrels, carrier, and inner breech, when the gun is in operation The locks also have, as stated, a reciprocating motion when the gun is rotated The gun cannot be fired when either the barrels or locks are at rest

"This brief description will convince any intelligent person at all acquainted with mechanical principles, that the 'Gatling battery,' in its distinctive features, is unlike all other fire-arms

"There is a beautiful mechanical principle developed in the gun, to which I would direct special attention, *viz*, that, while the gun itself is under uniform constant rotary motion, the locks rotate with the barrels and breech, and at the same time have a longitudinal reciprocating motion, per-

forming the consecutive operations of loading, cocking, and firing without any pause whatever in the several and continuous operations"

Three sizes of these batteries are made —

(1) The largest having six barrels with 1-in calibre, and throwing lead bullets of ½ lb weight

(2) Ten barrels, calibre 75 in, and lead bullets 4½ oz

(3) Ten barrels, with calibre to suit the musket cartridges of different governments

The rapidity with which the largest size fires, is about 150 to 200 shots per minute, the second size more than double the above rate of fire The largest-sized "Gatling" has a range of 3,000 yards, and is said to be very portable, as it can be taken apart, packed on mules, and carried up or across mountains, and put together in a few minutes

Picric Powder—Invented by Mr Abel It is of a bright yellow colour It is far more powerful than gunpowder, and very satisfactory results have been obtained from it It appears to be less susceptible than gunpowder to ignite by means of friction or a blow It is now being experimentalised upon by the Committee on Explosives It is likely to form a good bursting powder for shells

Voltaic Battery— The combination of a number of cells, each of which generates a certain quantity of dynamic or voltaic electricity To M Volta we owe the first knowledge of the powers of voltaic circuits, as shown by him in the *couronne de tasses* and the galvanic pile For mining purposes the battery devised by Professor Grove is the most suitable, in which the metals are zinc and platinum, —the former in a solution of diluted sulphuric acid, and the latter in pure nitric acid, the liquids being separated by a porous earthenware cell. (*Vide* Instruction in Military Engineering, 1870)

APPENDIX.

STANDARD WEIGHTS AND MEASURES OF GREAT BRITAIN AND ITS COLONIES

THE IMPERIAL MEASURES, INTRODUCED JANUARY 1ST, 1826

Avoirdupois, or Commercial Weight

		MARK
10831 cubic inches of pure water, at 62° Fahrenheit, or 27 34375 grs troy	= 1 dram,	*dr*
16 drams	= 1 ounce,	*oz*
16 ounces	= 1 pound,	*lb*
14 pounds	= 1 stone,	*st*
2 stones, or 28 pounds	= 1 quarter,	*qr*
4 quarters, or 112 pounds	= 1 hundred-weight,	*cwt*
20 hundred-weights, or 2,240 pounds	= 1 ton,	*T*

NOTE —The stone is principally used in weighing hay, straw, and live cattle, and commonly called Jockey Weight

Troy Weight

Is used in weighing gold, silver, and precious stones, and also in estimating the results of philosophical experiments

		MARK
1 901306 cubic inches of pure water, at 62° Fahrenheit	= 480 grains,	*gr*
24 grains	= 1 pennyweight,	*dwt*
20 pennyweights	= 1 ounce,	*oz*
12 ounces	= 1 pound,	*lb*

NOTE —Avoirdupois	lbs	×	1 21528	= Troy	lbs
„	oz	×	9115	= „	oz
Troy	lbs	×	823	= Avoi	lbs
„	ozs	×	1 1	= „	ozs
„	grs	×	03657	= „	drs

Lineal Measures, or Measures of Length

The English Standard Yard of 1760, and now lodged in the custody of the Clerk of the House of Commons, is made the standard or unit for all measures of extension whatsoever, and one-thirty-sixth of such yard = 1 inch

7 92 inches	= 1 link
12 ,,	= 1 foot
3 feet	= 1 yard
6 feet	= 1 fathom
16½ ,, or 5½ yards	= 1 rod, pole, or perch
792 inches 66 feet 22 yards, or 4 poles	= 1 chain
220 yards 40 poles, or 10 chains	= 1 furlong
5280 feet 1760 yards 320 poles 80 chains, or 8 furlongs	= 1 statute mile
6082 6 feet, or 2027 5 yards	= 1 nautical mile

Square or Superficial Measures

144 square inches	= 1 square foot
9 ,, feet	= 1 ,, yard
272¼ ,, feet or 30¼ ,, yards	= 1 pole or perch
40 poles	= 1 rood
4,840 square yards or 10 ,, chains	= 1 acre
640 acres	= 1 square mile

Cubic Measures, or Measures of Solidity and Capacity

1728 cubic inches	= 1 cubic foot
27 ,, feet	= 1 ,, yard
5 ,, feet	= 1 barrel bulk of shipping
42 ,, feet	= 1 ton of shipping
A load of unhewn timber	= 40 cubic feet
,, squared ,,	= 50 ,,
A cord of wood	= 128 ,,

FRENCH WEIGHTS AND MEASURES,

AS MOST FREQUENTLY REQUIRED FOR ENGLISH COMPARISONS

Weights

1 milligramme = 015438 English Troy grains
1 gramme = 15 438 ,, ,, ,, or 002205 of a lb Avoirdupois
1 killogramme = 2 2048 lbs Avoirdupois

WEIGHTS AS POPULARLY ESTIMATED

		lbs	ozs	drs	Avoirdupois
1 gramme	=	0	0	0½	
1 decagramme	=	0	0	5¾	
1 hectogramme	=	0	3	8½	
1 kilogramme	=	2	3	4½	

Lineal Measures

1 millimetre	=	039371	English inches
25½ "	=	1	" inch
1 metre	=	39 371 or 39⅜	" inches, or
	=	3 2809 feet = 3 feet 3⅜ inches	

Measures of Surface

1	centiare	=	1 196	English sq yds, or 10 764 English square feet
9 3	centiares	=	100	" " feet
1	are	=	119 6	" " yards
40 47	ares	=	1	" statute acre
1	hectare	=	2 47	" "

Measures of Solidity

1 millistere	=	035317	English cubic feet
1 stere	=	35 317	" "

Measures of Capacity

1 litre = 61 028 English cubic inches

POPULAR MEASURES OF CAPACITY

		English galls	qts	pts	Imp
1 litre	=	0	0	1¾	
1 decalitre	=	2	0	½	
1 hectolitre	=	22	0	0	
1 kilolitre	=	220	0	0	

Conversion of Equivalent Measures

English to French					French to English		
Inches	×	0254	=	metres	×	39 371	= inches
Feet	×	30477	=	"	×	3 2809	= feet
Yards	×	91438	=	"	×	1 09364	= yards
Miles	×	1 6093	=	kilometres	×	62138	= miles
Acres	×	40467	=	hectares	×	2 4712	= acres
Imp galls	×	4 54339	=	litres	×	2201	= gallons
Cubic ins	×	01639	=	"	×	61 028	= cubic ins
Bushels	×	36347	=	hectolitres	×	2 75125	= bushels
Quarters	×	2 9077	=	"	×	3439	= quarters
Troy grs	×	06479	=	grammes	×	15 434	= Troy grs
Troy lbs	×	3732	=	kilogrammes	×	2 6795	= Troy lbs
Avoir lbs	×	4535	=	"	×	2 2048	= Avoir lbs

Table of the principal Dimensions and Weights of various Horse Artillery Guns and their Equipment, taken from the Proceedings of the Royal Artillery Institution for May 1870, *as furnished by Colonel Maxwell, R A, in his Lecture read at that Institution on the new Field Gun for India*

	Breech loaders		Muzzle-loaders		Breech-loaders	Muzzle-loaders
	Prussian	English	Austrian	French	Russian	Indian
	4 pr	9 pr	4 pr	4 pr	4 pr	9 pr
THE GUN						
Calibre in	3.089	3	3.17	3.41	3.42	3
Number of grooves	12	38	6	6	12	3
Depth " in	0.051	0.015	0.175	0.113	0.051	0.11
Width " in	in front 0.6 in rear 0.71	0.148	1.54	0.67	0.61 0.77	0.8
Length of bore rifled in	59.6		42.2	49.4	47	63.5
Pitch angle degrees	3° 45′	1° 13′	8° 30′	6° 53′	1° 35′	5° 59′
Length of bore calibres	22.5	17.5	15	16	17	21.2
Weight of piece cwt	5.113	6.5	5.177	6.5	6.43	8.1
AMMUNITION						
Diameter of common shell in	3.089 3.192	3.02 3.07	3.089	3.305	3.418 3.522	2.94
Length of nose of do "	1.86		3.19	2.83	2.08	3.13
Length of cylinder of do "	4.47		3.91	3.47	1.83	4.8
Total length of do "	6.33		7.1	6.3	6.91	7.93
Weight of common shell filled lbs	8.96	8.5	7.99	8.9	12.5	9
Weight of common shell bursting charge oz	5.9	5	7	7	7.9	7.5
Number of balls in shrapnel		42	80	85		63
Weight of shrapnel lbs		9	8.03	9.72		9.25
Number of balls in case shot	48		56	41	40	108
Weight of case shot lbs	6.59		7.94	9.73	8.43	9
Service charge of powder	1.1	1.125	1.1	1.21	1.35	1.75
Ratio of weight of charge to shell	1/8.1	1/8	1/7.3	1/7.4	1/9.3	1/5.1
Initial velocity ft per sec	1,184	1,058	1,093	1,066	[illegible]	1,381
GUN CARRIAGE						
Track in	60.24	62	59.7	56.3	58	62
Diameter of wheel "	61	60	52.5	56.29	48	60
Weight of gun carriage, equipped, but without gun cwt	9.35	10.5	8.6	8.42	8.39	10.5
Weight of gun carriage equipped, but with gun cwt	14.04	17	13.78	13.88	14.07	18.75
Rounds carried on gun	1		3	4		4
LIMBER						
Diameter of wheel in	48.6	60	43.2	56.3	48	60
Weight of limber, packed cwt	15.75	15	9.86	10.1	8.95	14 14.6
Number of rounds in limber	48	34	36	40	18	30 36
Proportion of ammunition in limber: common shell	40	6	20	32	8	8
carcass	4					
shrapnel			10	5	6	16
segment		18				
case shot	4	10	6	3	4	6
MISCELLANEOUS						
Weight of gun behind team cwt	30.5	31.5	23.63	25.76	24.4	33.5 31.1
Number of horses in team	6	6	4	4	4	6
Weight for each horse in draft, men dismounted cwt	5.1	5.2	5.9	6.4	6.1	5.7
Number of rounds per gun, limber, and one wagon	157	124	156	156	130	134 148
Number of men carried: on limber	2	2	1		2	2
on gun	3		3	3	3	

N B—The numbers bracketed in the column referring to the Indian gun are to be taken according to whether each ammunition box contains 15 rounds only, or is filled up with 18

Kit of a Royal Artilleryman in India, and how disposed of

Dismounted Men				Articles	Mounted Men				
Knapsack	In Wear	Black Bag	Establishment		Establishment	Valise	In Wear	Black Bag	Wallets or on Saddles
1			1	Account Book	1	1			
1			1	Bible and Prayer Book	1	1			
		1	1	Black Bag	1			1	
		1	1	Blacking Tin	1				1
1	1		2	Boots, Prs	3	1	1		
		1	1	Brushes: Cloth	1	1			
		1	1	Brushes: Button	1	1			
		1	1	Brushes: Hair	1	1			
1			1	Brushes: Shaving	1	1			
2			2	Brushes: Shoe	2				2
				Brushes: Harness	1				1
				Brushes: Hard	1				1
				Brass Ball	1	1			
				Comb Mane	1	1			
1			1	„ Hair	1	1			
				„ Curry, „ Brushes	2				2
				Drawers	2	1	1		
1			1	Forage Cap	1				1
1			1	Great Coat	1				1
	1		1	Gloves	1		1		
	1		1	Helmet	1		1		
	1	1	2	„ Covers	2		1	1	
	1	1	2	„ Turbans	2		1	1	
				Horse Rubber	1				1
1			1	Hold all	1	1			
		1	1	Jacket	1	1			
1			1	Knapsack					
1			1	Knife and Fork	1	1			
1			1	Mess Tin	1				1
				Nose Bags	2				2
				Oil Can	1				1
				Overalls	1		1		
1			1	Razor and Case	1	1			
1			1	Straps, Mess Tin	1				1
2			2	„ Great Coat	3				3
	1		1	„ Foot	1	1			
				„ Valise	3	3			
				Spurs	1		1		
				Stable Bag	1				1
1			1	Spoon	1	1			
		1	1	Sponge	1				1
2	1		3	Socks	3	2	1		
		1	1	Stick, Button	1	1			
1	1		2	Shirts, Flannel	2	1	1		
	1	2	3	„ Cotton	3	2	1		
		1	1	Shaving Bag	1	1			
				Scissors	1	1			
		2	2	Towels	2	2			
1	1		2	Trowsers	1	1			
	1		1	Tunic, Cloth	1		1		
		1	1	„ Serge	1			1	
				Valise	1	1			
	1	1	2	Waist Belt, Flannel	2		1	1	
		4	4	White Coats	4			4	
		4	4	„ Trowsers	6			6	